STYLE MANUAL FOR BIOLOGICAL JOURNALS

Prepared by the
Committee on Form and Style
of the
Conference of Biological Editors

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PREFACE

This style manual is designed for research workers preparing manuscripts for publication in biological journals and for students and other prospective authors. Style is interpreted broadly to mean forms of expression in scholarly writing and the general technical requirements of journals, such as details for typing manuscripts, standard abbreviations and citation of references.

Not all fields can be covered completely, but it is our hope that this manual will be accepted, at least in part, by most biological disciplines. The instructions and recommendations represent good usage and practice; if followed, they will establish high standards in biological publication.

The 8 journals adopting this manual, in whole or in part, to date are:

Agronomy Journal
American Biology Teacher
American Institute of Biological Sciences Bulletin
American Journal of Botany
American Journal of Human Genetics, The
American Journal of Physiology
American Midland Naturalist, The
American Potato Journal
Annals of the Entomological Society of America
Applied Microbiology
Archives of Oral Biology
Arthritis and Rheumatism
Association of Southeastern Biologists Bulletin, The
Auk, The: A Quarterly Journal of Ornithology
Bacteriological Reviews
Biological Abstracts
Biologist, The
Blood
Brittonia
Bryologist, The
Bulletin of the Entomological Society of America
Bulletin of the Florida State Museum, Biological Sciences
Bulletin of the Research Council of Israel, Section B, Zoology; Section D, Botany; Section E, Experimental Medicine
Bulletin of the Torrey Botanical Club
Copeia
Ecological Monographs
Ecology
Economic Botany
Entomological News
Federation Proceedings
Forest Science
Green Thumb, The
Growth: A Journal for Studies of Development and Increase
Human Biology
Illinois Natural History Survey Biological Notes
Illinois Natural History Survey Bulletin
Illinois Natural History Survey Circular
Illinois Natural History Survey Manual
International Bulletin of Bacteriological Nomenclature and Taxonomy
Iowa State Journal of Science
Iowa, State University of, Studies in Natural History
Journal of Applied Physiology

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Committee on Form and Style
J R. Porter Chairman

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George B. Cummins	Robert V Ormes
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H. B Vickery

Journal of Bacteriology
Journal of Biological Chemistry
Journal of Dairy Science
Journal of Economic Entomology
Journal of Histochemistry and Cytochemistry The
Journal of Immunology
Journal of Insect Pathology
Journal of Lipid Research
Journal of Mammalogy
Journal of Parasitology The
Journal of Protozoology The
Journal of the National Cancer Institute
Journal of Wildlife Management
Limnology and Oceanography
Lloydia, A Quarterly Journal of Biological Science
Metabolism
Ohio Journal of Science The
Papers of the Michigan Academy of Science, Arts and Letters
Physiological Reviews
Physiologist The
Phytopathology
Plant Physiology
Proceedings of the Academy of Natural Sciences Philadelphia
Proceedings of the Biological Society of Washington
Progress in Cardiovascular Diseases
Public Health Reports (U S.)
Quarterly Journal of the Florida Academy of Sciences The
Quarterly Review of Biology The
Science
Soil Science Society of America Proceedings
Systematic Zoology
Transactions of the American Microscopical *Society*
Weeds
Wildlife Disease
Wildlife Review
Wilson Bulletin, The

The Committee on Form and Style of the Conference of Biological Editors has been responsible for preparing this manual But without the cooperation, suggestions and talents of many people the project would have been impossible Drafts of the manual have been read by approximately 100 editors and publishers. W O Nagel Technical Writer for the Missouri Conservation Commission has served as a valuable technical consultant to the Committee. Past and present officers (Bentley Glass, Milton O Lee Fred R. Cagle Wallace O Fenn, James G Dickson and Hiden T Cox) of the Conference of Biological Editors and the American Institute of Biological Sciences have helped in many ways. The National Science Foundation provided generous financial support. To these people and agencies the Committee expresses its thanks and appreciation.

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I WRITING

GENERAL PRINCIPLES

Learn to write effectively. To referees and editors, and especially to readers, you owe accurate, clear, and concise writing. You also owe brevity to the publishing journal, since costs are high and competition for space is keen. Prepare your manuscript carefully and in standard format (for example, double spacing between lines, proper headings, and style).

Lead the reader from a clear statement of your subject (or purpose) through the procedures and data, on to conclusions. Think of your paper as having these main parts: abstract, introduction, materials and methods, results, discussion, and literature cited.

The introduction should open with a succinct statement of the subject, should orient the report in its field, and should explain the purpose within the above orientation.

Describe your materials and methods in sufficient detail so that another worker can repeat the exact procedures. Arrange the data in unified and coherent sequence, so that the report develops clearly. Use only such tables, photographs, drawings, or charts as are necessary to clarify and document the text.

In the section dealing with results, omit extensive discussion.

The discussion section should relate the new findings with previous results and include logical deductions. The abstract should summarize only the major results and conclusions.

CONCISE LANGUAGE

Use words with precision, clarity, and economy. Every sentence should be as exact and simple as possible. Economy and accuracy require using the straightforward English sentence with all parts showing: subject, verb, and object.

Follow a consistent pattern of tense. Record observations and experiments in the past tense; use the present tense for generalizations and references to stable conditions.

Use the passive voice sparingly. It requires extra words and may not convey the exact meaning. Compare *Fungi produce antibiotics* with *Antibiotics are produced by fungi*. The passive here requires two more words and 25% more space. Worse, its idle words are not merely superfluous; they obscure the words that do the work. *It was found to have had* is simply, in the active voice, *It had*.

The multiplication of resistant white pine trees by means of making grafts has been already demonstrated as a feasible possibility. On an experimental basis as was explained earlier, over 1,000 grafts have been made and grown successfully during these studies in both green house [greenhouse] and field conditions. Yet a grafted tree has been found relatively expensive because of the necessity, according to present technique, of using green house space in the winter time and cold frames in the spring. Counting scions, stock, pots, labor, et cetera, each graft is estimated to cost about 12 cents. This cost might be reduced somewhat if further research will be done to further improve the methods employed. It might also be reduced by poting (sic) this operation on the basis of a large scale commercial production. Even at this relatively high figure grafting may now be done as a practical possibility due to the high price paid for certain types of ornimental [sic] planting. But the most promising means that has appeared of reducing the cost of propagating rust resistant white pine trees is through the rooting of cuttings.

Careful rewriting can weed out most of this:

Propagation of rust-resistant white pine by grafting is feasible, but grafted trees are too expensive (about 12 cents each), except for certain ornamental plantings. Improved technique and large-scale commercial production may reduce the cost of grafted trees, but the use of rooted cuttings seems more promising.

ACCURACY

Use words in their exact meaning, checking carefully with a dictionary. Where there are synonyms, select the one that conveys your meaning. Consider, for example, whether two objects are joined, connected, united, linked, annexed, coupled, associated, or attached; they may even inosculate or anastomose, or perhaps they merely communicate or interdigitate.

Make sure you use technical terms correctly; when in doubt check with someone who knows. If you used spinach *leaves* or the *flower-buds* of cauliflower or carrot *roots*, say so at least once. If *serum*, specify the animal; if tea or tobacco, is it the green leaf or the prepared leaf of commerce? The reader can only guess if you do not make such important detail clear.

THE NOUN-HABIT

Unfortunately, some professors and even some editors have bad linguistic habits. Misuse of nouns as adjectives, especially in clusters, is increasing ("a new type motor skills college performance test"). Ask biologists to express *avoiding* something, and we will probably make a noun phrase, *the avoidance of*. Only with effort can we resist the tendency to catergorize, to use nouns instead of adjectives or participles (verbal adjectives). We write *in length* instead of *long*, *of a peculiar order* instead

Biological publications now cost almost six cents a word But more than money is at stake Economy of communication and reading time is the major concern Economy of words also yields clarity *I found* costs less than half as much as *it was discovered* and identifies the discoverer immediately When *experiments were conducted*, the reader cannot tell whether the author or his predecessors conducted them. If you use *I* or *we* (*we* for two or more writers never as a substitute for *I*) you easily avoid the passive voice at least in that one sentence *I* may embarrass *the writer* but it takes exactly one tenth the space It is also clearer for *the writer* is often ambiguous

> These analyses, according to Smith, were inconclusive Though the samples analyzed were collected from localities unknown to the writer

When you finish your first draft, study each sentence to see whether you can shorten or even omit it Delete unnecessary words. If each deletion saves six cents, your total effort may save several dollars, and greatly increase your clarity and accuracy You may even enjoy this word game and the prize is increased professional competence *It is interesting to note that*, for instance, does no real work. Change every *It was discovered that* to *I found* change every *It was reported by Smith* to *Smith reported*. Be alert for *by* as the danger sign of the passive voice *Which* and *of* may be signs of wordiness. The words *very much*, *more* and *quite* have a place but are frequently misused as super-superlatives. If a word expresses an absolute quality or condition the comparative has no place. For example something can be complete immediate adequate sterile or universal it cannot be very complete quite adequate more sterile etc

Avoid the habitual phrases and jargon of your field (this does not mean technical terms) and use simple words Short words are clear and save space. Compare *But* (no comma) with *However* (and comma) as a sentence beginning *But* saves over 60 %

Writing can be too compact but wordiness is the common fault it should be corrected before you test for excessive terseness.

The final test (to be applied constantly sentence by sentence) is whether the meaning is simply and clearly stated Rewrite your paper several times then get help from a patient critical colleague he may find faults you have overlooked.

Unnecessary repetition extraneous detail and loose phrases can obscure even simple ideas. Here is a paragraph (cited by Riker 1940) from a paper submitted for publication

The multiplication of resistant white pine trees by means of making grafts has been already demonstrated as a feasible possibility. On an experimental basis as was explained earlier, over 1,000 grafts have been made and grown successfully during these studies in both green house [greenhouse] and field conditions. Yet a grafted tree has been found relatively expensive because of the necessity, according to present technique, of using green house space in the winter time and cold frames in the spring. Counting scions, stock, pots, labor, et cetera, each graft is estimated to cost about 15 cents. This cost might be reduced somewhat if further research will be done to further improve the methods employed. It might also be reduced by putting all this operation on the basis of a large scale commercial production. Even at this relatively high figure grafting may now be done as a practical possibility due to the high price paid for certain types of ornamental planting. But the most promising means that has appeared of reducing the cost of propagating rust resistant white pine trees is through the rooting of cuttings.

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JARGON

In science, jargon is the shorthand or slang of technical language. In chemistry for instance, *supernate* is laboratory jargon for *supernatant fluid*. All fields similarly manufacture words by adding *-ate*, a suffix indicating the result of a process *filtrate* is "that which has been filtered." But even with this common word, writers sometimes confuse the clarified liquid (properly the filtrate) with the residue left on the filter Both in a sense, "have been filtered. Such inventions as *dialysate* and *centrifugate* compound the confusion, and terms such as *shockate*, *washate*, and *sonicate* are not even understandable. Thoughtless prefixes also produce jargon *Preincubate unincubated, prewarmed, pre-test phase.* Biology shares with advertising the poor practice of concocting verbs from adjectives by adding *-ize solubilize, finalize personalize.* Business has blessed science with *percentagewise*. But science is responsible for experimenting with *re-* as a prefix for new compound verbs, e.g., *rehydrolyze, reisolate, reincubate.*

Many writers use intransitive verbs, which do not take an object or have the passive voice, as if they were transitive One cannot "react alcohol with acetic acid," or state that "alcohol was reacted with acetic acid," or have an "unreacted substance."

Read your paper aloud to uncover such tongue-twisters as "preformed performic acid was prepared," and such jingles as "cessation of saturation," "periodical general physical," and "conducted protracted."

GOOD EXAMPLES OF BAD HABITS

Here are some imperfections and possible corrections

Abuse	*Correction*
Our research, designed to test the fatal effects of XXX on dogs was carried out by intravenously introducing the drug. In the experiments a relatively small quantity 3 cubic centimeters was administered to each animal. In each case XXX proved fatal, all dogs expiring before lapse of five minutes after the injection	The intravenous injection of only 3 ml of XXX kills a dog within 5 min.

of *peculiar*, and *of great importance* instead of *important*. We use the relative pronoun (usually *which*) rather than an adjective or participle "a technique *which was* widely *in use* five years ago" rather than "a technique widely used five years ago" Noun constructions the passive voice and inaccurate wording combine to obscure meaning and waste space

OF AND WHICH

Here is a passage (cited by Baker 1956) suffering from the *of and which* disease

Many biological journals especially those *which* regularly publish new scientific names now state in each issue the exact date *of* publication *of* the preceding issue In dealing with journals *which* do not follow this practice or with volumes *which* are issued individually the biologist often needs *to* resort *to* indexes in *order to* determine the actual date *of* publication *of* a particular name

Eliminate *of*'s and the nouns they bring in change *which* phrases into participles, and nouns into verbs, and you have

Many biological journals especially those regularly *publishing* new scientific names now give the date of the preceding issue For journals not *adhering* to this practice and in some books the biologist must turn to indexes *to date* a particular name

Wisely used, a participle saves at least one word (the linking *which*) and often eases a passage built entirely of static *of* and *which* segments.

DANGLING PARTICIPLES

When not carefully placed, participles dangle they modify the wrong word especially when the passive voice has eliminated the right one

Judging by present standards these trees are
Looking through the microscope the cells could be
Nitrogen was determined using the Kjeldahl method

The simplest remedy for the first example is to change the present to the past participle 'judging' to 'judged. It might be better to bring the subject forward in the sentence "These trees judged by present standards, are ' The next two examples profit from dropping the participle altogether 'Under the microscope, cells could be ' Nitrogen was determined by the Kjeldahl method " A common renegade among participles is 'following' in the sense of after as in following the talk he visited the laboratory *Present participles functioning as* simple adjectives often adhere to the wrong noun What does the enzyme oxidizing malate" mean malate that oxidizes the enzyme or the enzyme that oxidizes malate"? The second meaning is correct Even

only implies a continuous process in the present. Use a cautious *which* or preferably *that* "the enzyme that oxidizes malate." Good usage favors *that* for defining-clauses and *which* for descriptive clauses (those set off by commas) If a participle dangles or clings the wrong way a *that* may save you from the *whiches*.

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Abuse	*Correction*
A method, which was found to be expedient and not very difficult to accomplish and which possessed a high degree of accuracy in *its results* was *devised* whereby	An easy accurate way to
The quantitative findings reported by Smith were analyzed and seemed, according to our interpretation to contain significant inconsistencies Our reasons for attaining this diverse opinion are	We think Smith s *measurements are* questionable because
Of the utmost importance is the need to examine quantitatively the various instars which have not reached maturity in order to evaluate and determine the validity of the theory advocated by *Przibram*	To test Przibram s hypothesis all immature instars must be measured.

Wordy	*Concise* (Kesling, 1953)
an innumerable number of tiny veins	innumerable tiny veins
as can be seen from the following Table (*or* Fig)	data in Table (*or* Fig) x show
at the present moment	now
bright green in color	bright green
by means of	by with
conducted inoculation experiments on	inoculated
contemporaneous in age	*contemporaneous*
created the possibility	made possible
due to the fact that	because
during the time that	while
equally as well	equally well
fewer in number	*fewer*
for the reason that	because since
from the standpoint of	according to
goes under the name *of*	*is called*
I shall with your permission offer some brief observations	May I say a few words
in order to	to
in terms of	in
in the event that	if
in view of the fact that	since because
it is possible that the cause is	the cause may be
it is this that	*this*
it would thus appear that	apparently

Wordy	*Concise*
lenticular in character	lenticular
masses are of large size	masses are large
of such hardness that	so hard that
on the basis of	from, by because
plants exhibited good growth	plants grew well
sacrifice (for kill)	kill
serves the function of being	is
the fish in question	this fish
the tests have not as yet	the tests have not
the treatment having been performed	after treatment
there can be little doubt that this is	this probably is
they are both alike	they are alike
throughout the entire area	throughout the area
throughout the whole of the experiment	throughout the experiment
two equal halves	halves
we will always have a miscellany of quality in terms of illustrations	the quality of illustrations will always vary
with reference to	about
As already stated	Omit such introductory phrases
Concerning this matter it may be borne in mind that	
In this connection the statement may be made that	
It is interesting to note that	
It has long been known that	
It may be said that	
Typical results are shown	
With respect to the occurrence of these types it has been found that	

Bad Reference	*Good Reference*
As far as my own observations are concerned, they show	My observations show
As far as this fauna is concerned, it	This fauna is
As for the frog, they are	Frogs are
It has not been possible to identify it with any of the described forms and it seems to be so distinct that it is probable that additional examples could be recognized without difficulty	I could not identify it, but it is so distinct that additional specimens could easily be recognized.

Nonsense	*Sense*
This book fills a much needed gap	This book is much needed
What we need is a list of biologists broken down by specialization	What we need is a list of biologists classified by specialties

Nonsense	*Sense*
While flying over Fort Churchill in a Polar Cub two foxes were seen in a highly abnormal condition	From a Polar Cub flying over Fort Churchill *I saw* two foxes in a highly abnormal condition
On November 2 1957 a porcupine was brought to the laboratory by a wildlife biologist *in a moribund condition*	On 2 November 1957 a wildlife biologist brought a moribund porcupine *to the laboratory*

SPELLING AND USAGE OF COMMON WORDS

Follow the current edition of *Webster's New International Dictionary* for spelling and division of words. Use the first choice where a choice is given. *Use great care in spelling foreign names and words, making sure* that accents and other diacritical marks (*see* p 32) are correct The forms listed below are good usage

acclimatize
acetylcholine *no* hyphen
acknowledgment
aesthetic *or* esthetic
after (later in time subsequent) *see* following
agenda (things to be done or dealt with) *singular* agendum
agglutinin adsorption *not* agglutinin absorption
albumin (albumen means white of egg)
alga *plural* algae
aliquot better to *substitute* sample portion or fraction (Aliquot means integral fraction Strictly speaking one cannot take a 3 ml aliquot from 10 ml of solution)
all right *never* alright
amino acid *no* hyphen
amoeba *or* ameba for common term, *but* *Amoeba* as a generic name
ampoule ampule *preferred to* ampul
anaerobic *not* anerobic
analogue
analyze
and/or *avoid use of*
anesthesia *not* anaesthesia
anticholinesterase *one word*
autolyzate *or* autolysate
autolyze *but* autolysis
autopsy (postmortem examination) *see* necropsy
bacillus *plural* bacilli (noun)
bacterial (adj)
bacterium *plural* bacteria (noun)
baker s yeast
basis *plural* bases
bio-assay
biological *preferred to* biologic
biuret
brain stem, *not* brainstem
breakdown (noun) break up (noun)
brewer s yeast
Büchner funnel *not* Buchner
Buchner hydraulic press or press juice
burette *or* buret
canceled canceling
cancellation
cannot
carcass carcasses
catalogue *or* catalog
catalyze
catecholamines
cellophan cellophane
cholinesterase
cocarboxylase
coccus *plural* cocci
cod liver oil
compared with *instead of* compared to

(unless comparisons are greatly dissimilar)
controlled, controlling
cooperate cooperation
coordinate
corn oil
countercurrent
co-worker
criterion *plural*, criteria
criticize
crystalline, crystallize
curriculum *plural* curricula
cytochrome c, a, etc
dark-eyed, dark-haired *before* a noun
darkroom (photography)
data (plural) *singular* datum
daylight (time)
deep-rooted, deep-seated *before* a noun
deoxy (prefix) *not* desoxy
desiccate
desiccator
dialysis
dialyzation, dialyze
dipolar ion, *not* zwitter ion
disc *preferred to* disk
durall
double-cross (noun and verb)
due to (as adjective must refer to noun) *see* owing to
electronmicrograph
embryo *plural*, embryos
endemic (affecting few people local)
end plate end point
envelop (verb)
envelope (noun)
enzootic (affecting few animals local)
enzymatic enzyme
epidemic (affecting many people at once widespread)
epiphytotic (affecting many plants at once widespread)
epizootic (affecting many animals at once, widespread)
equilibrium; *plural* equilibria
estrous (adj) *not* oestrous
estrus (noun) *not* oestrus
extracellular no hyphen
eyeball, eye color
eyepiece micrometer
farther (comparative of far)
focused, focusing
fold (words with suffix *fold* are solid, except when Arabic numeral is used as 4-fold)
following (immediately to be treated) *do not use for* after
foothill, footprint
formalize formalization
former and latter *avoid* and *never* use when referring to more than two antecedents in a sentence
formula *plural* formulas
fourfold *see* fold
fractions, use hyphen in one-half one third, etc., but use decimal system with Arabic numerals as 0.5 0.33, etc.
free from, *not* free of
freeze-dried
freezing point
fuller's earth
fungous (adj)
fungus (noun) *plural* fungi
further (in addition)
gall bladder
gallnut
gastrointestinal
gauge
gelatin, *not* gelatine
genus; *plural*, genera
germ cell
gladiolus *plural* gladioli or gladioluses. *But Gladiolus* as generic name.
gram-negative (adj)
Gram's stain
gray *preferred to* grey
half life (noun and adj)
halftone (in engraving)
hemocoele *preferred to* hemocoel
hemorrhage *preferred to* haemorrhage
homologue *not* homolog
hydrolysis (noun) *plural* hydrolyses
hydrolyze (verb) hydrolyzate (noun)
hypothesis *plural* hypotheses
hypothesize *not* hypothecate

index *plural* indexes or indices (of refraction mathematical)
indole
infrared
innocuous (adj)
inoculate
inoculum *plural* inocula
insanitary (adj)
intra-arterial
intracardiac
intracellular
juvenile (noun adj)
Kjeldahl kjeldahlize
kneecap knee-deep
Krebs cycle
Krebs Ringer solution
label labeled
landfall landlocked
leukemia, preferred to leucemia
leukocyte *preferred to* leucocyte
lifelike life-size lifetime
like (words with suffix *like* are *solid* except where 'l is tripled as in shell like *or* in long words as pleuropneumonia like)
lipid (noun) *not* lipide lipin lipoid
lipoic acid, *not* thioctic acid
lipoid (adj)
lipoprotein
liquefy
matrix *plural* matrices
maximal (adj)
maximum (noun) *plural* maxima
medium *plural* media, mediums
micro Kjeldahl
micromethod
microorganism
midsummer
mold (noun verb)
mucin
mucous (adj) mucus (noun)
multicolored
necropsy (postmortem examination) *see* autopsy
Nessler reagent and Nessler test *but* nesslerize
ninhydrin
non (most words with this prefix are *solid*)
oasis *plural* oases
off-color *but* offshoot offshore
optimal (adj)
optimum (noun) *plural* optima
overall (noun) over-all (adj)
owing to (modifies a verb and means *because of*)
oxaloacetic acid
pandemic (widely epidemic in people)
panzootic (widely epidemic in animals)
per cent *use* symbol (%) with number
percentage (e.g the percentage of cells)
Petri *but* petri dish
phagocytosis (noun) *but* phagocytize (verb)
phenomenon plural phenomena
photochemistry
photomicrograph (in microscopy) *not* microphotograph
phylum *plural* phyla
pipette *or* pipet
poly post pre- (most words with these combining forms are solid)
protozoa *singular* protozoon. *But* Protozoa as phylum
protozoan (adj)
radioactive
radioautograph *not* autoradiograph
radioisotope
radius *plural* radii
Ringer s solution
separating funnel separatory funnel
septum *plural* septa
serum *plural* sera
skillful
solubilize *never use* (ize may be added to noun but not to adjective)
steam-distill
stopcock
syllabus *plural* syllabi
tapeworm
taproot tap water
taxon *plural* taxa
technique technic
thiamine

thioctic acid, see lipoic acid
thioglycolate
threefold, see fold
titer
trichloroacetic not trichloracetic
tryptophan (no final e)
turnover-number
Tween 80 = polyoxyethylene sorbitan monooleate *Use* capital and chemical name first time in text
twofold see fold
ultra- (most words with this prefix are solid, as ultracentrifuge ultraviolet)
vertebra plural, vertebrae
wavelength
weekday
while (of time) avoid using as conjunction instead of *although*, *and* *but*, *whereas*
wildlife
X-ray (adj) X ray (noun)
Y-shaped, Y form

PUNCTUATION

Punctuation requires the same care that selecting words and word order does. A good style (proper words in proper places) may require less punctuation than a bad one for punctuation must then do the work that word order might do better Nevertheless it is better to use unnecessary commas than to risk ambiguity

Period

1) Use a period (full stop)
   a) after a declarative or exclamatory sentence
   b) as a decimal point
   c) after abbreviations of given names (W B. Jones) and Latin words (e.g., i.e., et al.)
   d) at the end of a footnote
2) Use three spaced periods (ellipsis) when a word or a group of words within a sentence is omitted from quoted material, being careful to leave a space before and after thus "Mary had lamb." If the omitted words begin a sentence no ellipsis is necessary If the omitted words conclude a sentence, place the ellipsis before the period If the omitted words are the first part of a second sentence in the quotation place the ellipsis after the period. Notice the spacing after the word *period* in the two preceding sentences. If a paragraph is omitted in the quotation, use a whole line of periods. (Some publications use three asterisks)
3) Omit the period after
   a) capital-letter abbreviations of names of biochemical compounds (DNA) government agencies (AEC NSF USDA, NIH) societies (AIBS) international agencies (WHO UNESCO)

b) contractions and symbols for chemical elements and units of measurement The distinction between an abbreviation and a symbol is often tenuous. Thus, in running text mg (milligram) may be considered to be either and punctuated accordingly However in expressions of a mathematical type such as 2 mg/ml it is much better to regard the terms as symbols and omit the period. Some terms, such as μc (microcurie) cannot really be considered abbreviations
c) Roman numerals and ordinal numbers (22nd)
d) titles, subtitles, headings and major subheadings except run-in subheadings legends for tables
e) items in lists

4) In special situations place the period
a) inside the quotation marks when a sentence ends with a quoted phrase even when the period is not part of the quotation
b) inside or outside parentheses or brackets, depending on whether the parenthetical matter is an independent sentence (the period goes inside) or is a subordinate part of the main sentence (the period goes outside)

Centered or Raised Period

1) Use a centered period for
a) water of hydration in chemical formulas ($Na_2B_4O_7 \cdot 10H_2O$)

2) A centered period may be used to indicate
a) multiplication when equations are too crowded to permit use of the times sign (×) or when use of closed up or thinly spaced symbols is not satisfactory for example $k \times g \times (a + 2)$ may be printed $kg(a+2)$ or $k \cdot g \cdot (a+2)$ or $k \cdot g(a+2)$
b) chemical bonds if the standard bond sign occupies too much space
c) genetic expressions *AA* · *AB* · *BB* etc.

Comma

The comma provides separation or brief pause within a sentence and is helpful in grouping words, phrases and clauses for clarity and ease of reading Do not separate a subject and its verb or a verb and its object, except by phrases between commas. Noun phrases can act as subjects and objects and should not be set off with commas.

1) Use a comma
a) to separate two *independent* clauses joined by a coordinating

conjunction (*and*, *but*, *for* *yet*, *neither* *therefore* *or* *so*) (*See* 2a below *see also* p. 14.) If the clauses contain internal punctuation, separate them with a semicolon.

b) to set off a dependent introductory clause begun with a subordinating conjunction (*if* *although* *since* *when*, *where* *because*)

c) to separate words in apposition

d) to separate the elements (clauses words or phrases) in a series. If an element contains commas or other punctuation, separate with a semicolon. (If a series is constructed grammatically the parts will be parallel—that is each part can be read separately in the sentence without loss of sense)

e) to separate nonrestrictive (nondefining) clauses or phrases from the rest of the sentence (Nonrestrictive clauses or phrases give extra information that is not essential to the meaning of the sentence If you are uncertain whether the phrase is restrictive read the sentence without it if the meaning is materially altered, the phrase is restrictive)

f) to separate conjunctive adverbs (*therefore* *thus* *then* *still*, *however* *accordingly* *moreover* *nevertheless* *consequently*) and transitional phrases (*on the contrary* [*but* may do the work as well] *on the other hand* *in fact* *after all*, *in the first place* [*first* is better])

g) to set off a short quotation. If the quotation is long, use a colon

h) to set off inserted elements. From days 5 to 32 the growth, as shown in Fig. 1 was rapid."

i) to separate dates (years) and places. "The work was done on 3 April, 1939 at Madison, Wisconsin."

j) to set off contrasted words phrases or other elements "It is not " "The greater the less "

k) to separate words phrases and clauses placed out of their natural position for emphasis or clarity

l) to separate two adjacent sets of figures. "In 1933 100 experiments "

m) to group numbers in thousands 1,000 18,000 1,000,000

2) Omit the comma

a) if two independent clauses joined by a coordinating conjunction are short and no ambiguity results

b) after a short introductory phrase begun with a preposition, if no ambiguity results

b) *contractions and symbols for chemical elements and units of measurement* The distinction between an abbreviation and a symbol is often tenuous Thus in running text mg (milligram) may be considered to be either and punctuated accordingly However in expressions of a mathematical type such as 2 mg/ml, *it is much better to regard the terms as symbols* and omit the period. Some terms such as μc (microcurie) cannot really be considered abbreviations.

c) Roman numerals and ordinal numbers (22nd)

d) titles, subtitles, headings, and major subheadings except run-in subheadings *legends for tables*

e) items in lists

4) In special situations, place the period

a) inside the quotation marks when a sentence ends with a quoted phrase even when the period is not part of the quotation

b) inside or outside parentheses or brackets, depending on whether the parenthetical matter is an independent sentence (the period goes inside) or is a subordinate part of the main sentence (the period goes outside)

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a) water of hydration in chemical formulas ($Na_2B_4O_7 \cdot 10H_2O$)

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c) genetic expressions *A·A A·B B·B etc*

Comma

The comma provides separation or brief pause within a sentence and is helpful in grouping words, phrases and clauses for clarity and ease of reading *Do not separate a subject and its verb or a verb and its object*, except by phrases between commas. Noun phrases can act as subjects and objects and should not be set off with commas.

1) Use a comma

a) to separate two independent clauses joined by a coordinating

Question Mark

1) Use a question mark
   a) at the end of a direct question even if the question is presented in declarative form
2) Do not use a question mark
   a) after an indirect question
3) Place the question mark inside the quotation mark if the question mark is part of the quotation or outside if the mark is part of the sentence that includes the quotation.

Exclamation Point

The exclamation point is rarely justified in scientific writing

Dash

Do not substitute a dash (em) for a comma, semicolon or colon.

1) Use the dash sparingly
   a) to indicate an abrupt break or shift in thought
   b) to separate parenthetical matter especially to secure emphasis (but see Parentheses)
   c) within brackets within parentheses for a third level of interpolation. (Avoid this cumbersome construction.)
   d) to indicate that an important thought is coming next

Parentheses

1) Use parentheses
   a) to set off comment or explanation that is structurally independent of the sentence. (Parentheses indicate a greater independence than dashes.)
   b) to group mathematical expressions
   c) to label enumerations included within a paragraph. "The four steps were (i) (ii) (iii) and (iv) " (but do not label the enumerations unless necessary) (See Enumeration and Series p. 17)
2) Avoid use of double parentheses (( ))
3) Use single parentheses to set off enumerated paragraphs 1) a) i)

Brackets

1) Use brackets
   a) to set off insertions within quoted matter
   b) around parenthetical remarks inserted within other parenthetical remarks

c) around short appositives. "The species *Bombyx mori* ," "The respiratory quotient RQ is ."
d) after equations and formulas set off from the text by centering on the page

3) Place the comma
a) inside the closing quotation marks when a sentence continues beyond the end of the quoted phrase, even when the comma is not a part of the quotation
b) after a period that follows an abbreviation if the sentence requires a comma. Do not expect the period to do its own work and substitute for the comma also

Semicolon

The semicolon is a mark of coordination and therefore should not be used with dependent clauses.

1) Use the semicolon to separate
a) coordinate clauses not joined by a conjunction
b) coordinate elements containing internal punctuation
c) elements of a series if the elements contain internal punctuation
d) coordinate clauses joined by a conjunctive adverb (*however moreover also then*) (*Clauses introduced by subordinating* conjunctions [*because whereas inasmuch*] are separated by commas.)

2) Place the semicolon
a) outside the quotation mark

Colon

1) Use a colon
a) to introduce a long quotation (A comma is sufficient for short ones.)
b) to introduce a list or enumeration
c) to emphasize a sequence in thought between two complete sentences when the emphasis obtained by a period or word such as *namely* is insufficient
d) to separate *a complete clause from a following* illustrative clause or phrase
e) to separate parts of ratios (The slant line solidus, or virgule also serves this function if there are *only two elements in the* ratio but do not use the slant line in a three-element ratio)
f) in literature citations to separate volume and page numbers

1) It may be used instead of a colon to indicate ratio (3/4 or 3 4) but not in a ratio involving more than two elements. (The ratio 1.3 4 is clear 1/3/4 is not.)
2) Do not use the slant line as shorthand for per if more than one is required. To abbreviate "The strontium fallout was 1.5 micromicrocuries per square mile per year use the form 'The strontium fallout was 1.5 μμc/square mile year" or "1.5 μμc/(square mile × year)" so that both square mile and year fall in the denominator where they belong. Do not write "1.5 μμc/mi²/yr"
3) Avoid such expressions as *and/or* and *signal/noise ratio* The expression "The cultures were subjected to light and/or dark" can be expressed by "The cultures were subjected to light or dark, or both." Use a hyphenated compound, *signal-to-noise ratio*, instead of *signal/noise ratio*

Punctuation of Literature Cited

Follow the style indicated on pages 58-65. Separate the main parts of the citation—authors, date, article title, journal (or book name publisher and address) and volume and page numbers—with periods Use a comma between author's surname and his initials and between the publisher's name and the city Use a colon after the volume number or issue number Avoid issue number unless issue is paged separately use parentheses around issue numbers if accompanying volume number Use a hyphen between the extreme page numbers of the citation.

Enumeration and Series

Series range from three one-word elements to complex enumerations, each element of which may require a separate paragraph. Complex series are often overused and poorly constructed. If a complex series seems necessary consider whether the same purpose can be accomplished by separation into sentences, in proper order with use of indicative words such as *then when afterward* and *finally* In a properly constructed series simple or complex, each element can be read separately in the sentence without loss of meaning that is the elements are constructed in parallel. For example the sentence "The mixture was heated, shaken, centrifuged, and the supernatant fluid frozen" is not properly constructed for the last element cannot be read as part of the series. The first three elements make up a series, but the last must become a coordinate clause with a verb "The mixture was heated shaken, and centrifuged the supernatant fluid was frozen."

Apostrophe

1) Use an apostrophe
   a) and *s* (*'s*) to form the possessive of a singular noun, but the apostrophe alone to form the possessive of a plural noun ending in *s*
   b) to indicate omission of letters in a contraction, but contractions are inappropriate in scientific writing. No apostrophe is necessary in an abbreviation or symbol.
   c) and *s* to form the plural of letters, figures, and some words. "He uses too many *but*'s."

Quotation Marks

1) Use double quotation marks in the text around
   a) all direct quotations
   b) *titles of articles, parts of books, and series titles*
   c) new technical terms or old terms used in a new or unusual sense
2) Use single quotation marks around a word, title, or term within a quotation. Follow the rules for double quotation marks.
3) Special situations
   a) If a quotation extends over more than one paragraph, begin each paragraph with quotation marks, but close the quotation only at the end of the last paragraph.
   b) Relationship to other punctuation. (i) Place a comma or period inside the closing quotation mark, even if it is not part of the quotation. (ii) Place the colon and semicolon outside the quotation marks. (iii) Place question marks and dashes inside the quotation when they belong to the quotation, outside if they do not.

Hyphen

1) Use a hyphen
   a) between the numerator and denominator of a fraction when spelled out (one-third)
   b) between the parts of some compound words (see p. 18; also *Webster's* dictionary under compound, for discussion of hyphen)
   c) between numbers to indicate a range

Slant Line (Solidus or Virgule)

Since the slant line (/) is a mathematical mark of division ($3/4 = \frac{3}{4} = 3:4 = 3 \div 4$), it must be used with care.

1) It may be used instead of a colon to indicate ratio (3/4 or 3:4) but not in a ratio involving more than two elements. (The ratio 1:8:4 is clear: 1/3/4 is not.)
2) Do not use the slant line as shorthand for *per* if more than one is required. To abbreviate "The strontium fallout was 1.5 micromicrocuries per square mile per year," use the form "The strontium fallout was 1.5 $\mu\mu c$/square mile year" or "1.5 $\mu\mu c$/(square mile × year)" so that both square mile and year fall in the denominator where they belong. Do not write "1.5 $\mu\mu c/mi^2/yr$."
3) Avoid such expressions as *and/or* and *signal/noise ratio*. The expression "The cultures were subjected to light and/or dark" can be expressed by "The cultures were subjected to light, or dark, or both." Use a hyphenated compound, *signal-to-noise ratio*, instead of *signal/noise ratio*.

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Enumeration and Series

Series range from three one-word elements to complex enumerations each element of which may require a separate paragraph. Complex series are often overused and poorly constructed. If a complex series seems necessary, consider whether the same purpose can be accomplished by separation into sentences, in proper order, with use of indicative words such as *then*, *when*, *afterward*, and *finally*. In a properly constructed series, simple or complex, each element can be read separately in the sentence without loss of meaning; that is, the elements are constructed in parallel. For example, the sentence "The mixture was heated, shaken, centrifuged, and the supernatant fluid frozen" is not properly constructed, for the last element cannot be read as part of the series. The first three elements make up a series, but the last must become a coordinate clause with a verb. "The mixture was heated, shaken, and centrifuged; the supernatant fluid was frozen."

1) Punctuate all simple series with commas
   a) "The mixture was heated shaken and centrifuged"
   b) "The mixture was heated to 40 C shaken at 30 cycles per sec and centrifuged at 18 000 × *g*
2) Punctuate more complex series (those in which the individual elements contain their own punctuation) with semicolons.
   a) "The mixture was heated at 40 C for 10 min to inactivate , which , shaken at 30 cycles per sec and centrifuged at 18 000 × *g*"
   b) "The mixture was heated, shaken and centrifuged the pellet was discarded, and the supernatant fluid was quick-frozen and stored for 3 days at −10 C"
3) If a still more complex series and subseries combination is required, enumerate each element in the main series with a small Roman numeral in parentheses, (i) (ii) (iii) separate the parts of the main series with semicolons and punctuate the subseries with commas. If necessary go a step farther and make each part of the enumerated main series into one or more sentences.
4) In extremely complex series, paragraph enumeration may be required Begin each paragraph with an Arabic numeral and a single closing parenthesis.

COMPOUND WORDS

A compound word is a single word composed of two words joined together with or without a hyphen A compound word expresses an idea different in meaning or function from the idea expressed by the two separate words (*black bird*, possibly a crow *blackbird*) Solid compounds are, in general much more common in scientific writing than hyphenated compounds but occasionally a hyphen is needed to avoid a confusing sequence of letters (*freeze-dry cell-like red-eared sunfish*)

Two questions must be answered to determine whether a compound should be formed (i) is compounding desirable? and (ii) should a hyphen be used?

1) Compound nouns are separate when the two elements are both accented (e g *buffalo fish oak wood*) solid when the term has a special meaning and one of the elements has lost its accent (as, *blackboard*) The following compound nouns take a hyphen those made up of verb and noun or pronoun (*catch-all*) those made up of two verbs (*has-been*) and those naming a technical unit of measurement (*foot pound light year*)
2) Compound adjectives are hyphenated but a few are set solid

(usually those ending in *born, bred proof worthy* and certain others) Do not use a hyphen in a compound adjective formed from an adverb ending in *ly* and a present or past participle ("a quickly completed reaction")

3) Compound verbs formed from an adjective and noun, adjective and verb, verb and adjective or two verbs are hyphenated.
4) Compound adverbs are usually hyphenated.
5) Prefixes suffixes and combining forms Words in which prefixes, suffixes or combining forms appear are derivatives rather than compounds. Derivatives are usually set solid. The following are the most important exceptions (i) the prefix *self* (ii) the suffix *like* when the main stem ends in *l*, or contains several syllables (iii) any prefix used with a proper name (but in geology *Precambrian*) (iv) any prefix which, if set solid, would form a word easily confused with another—for example, *un-ionized* unionized (v) any form that would be confusing because of the doubling or tripling of a letter
6) Certain scientific societies approve lists of common or vernacular names of animals and plants that contain compound words Adopt these names because they represent good usage The Entomological Society of America approves the common names of approximately 1,500 insects (see p 54). In forming compound names (where one is a group name) for insects a separate word is used for the group name if it is systematically correct With few exceptions names ending in *bug fly hopper roach*, and *worm* are set solid. Names with a final element of *ant, aphid beetle borer caterpillar louse maggot, mosquito moth, roller tick* and *weevil* are set as two words Examples bedbug, housefly as contrasted with dog tick Argentine ant. The American Ornithologists' Union publishes a check-list (see p. 54) of vernacular names for species (but not subspecies) of North American birds Initial capital letters are recommended for the complete names of species, but not subspecies. Examples American Goldfinch, Brown-throated Wren, Orchard Oriole and Steller's Eider but goldfinch, wren, oriole, and eider
7) Plant names ending in *bean, berry bush, cup flower grass, lily seed, pod, root, thorn*, and *wort* are usually printed solid.

NUMERALS AND DATES

A standard rule in writing is that numerals should be avoided in running text except when more than two words are required to spell

out the number, but much space can be saved in research reports if numerals are used more frequently and they should certainly be used when precision must be indicated.

1) Use numerals whenever a number is followed by a standard unit of measurement such as *inch*, *milliliter*, or *curie*, or its abbreviation.
2) Otherwise use words through the number ten and numerals for larger numbers (*ten* animals, *14* parts), but in a series containing some numbers under ten and others over, use numerals for all.
3) In very large numbers substitute a word for part of the number (1.6 million, *not* 1,600,000), or add appropriate prefixes such as *mega*, *kilo*, *micro*, and *milli* to the basic unit of measurement. Powers of 10 may also be used. (*See below.*)
4) Always use numerals for dates, page numbers, and numerical designations, percentages, and expressions of time, as 1 January 1960, page 822, type 1, 27%, 10:15 PM.
5) Avoid beginning a sentence with a numeral.

METRIC AND DECIMAL SYSTEMS

The metric system for measures and weights is recommended in scientific writing because of its world-wide acceptance. In accordance with action taken by the 12th General Assembly of the International Union of Biological Sciences at Rome, 12–15 April 1955, the decimal system rather than fractions should be used in scientific publications.

The units of the metric system are the *meter* for linear measure, the *are* (100 m^2) for surface area, the *liter* (0.001 m^3 of space) for capacity, and the *gram* (1 ml of water at 4 C) for weight. In the metric system weights and measures larger and smaller than the *meter*, the *are*, the *liter*, and the *gram* are related to these units by the decimal system as follows (International Committee on Weights and Measures):

Multiples and Submultiples	*Prefixes*	*Symbols*
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^{9}	giga	G
1 000 000 = 10^{6}	mega	M
1 000 = 10^{3}	kilo	k
100 = 10^{2}	hecto	h
10 = 10	deka	dk
[The unit = one]		
0.1 = 10^{-1}	deci	d
0.01 = 10^{-2}	centi	c
0.001 = 10^{-3}	milli	m
0.000 001 = 10^{-6}	micro	μ
0.000 000 001 = 10^{-9}	nano	n
0.000 000 000 001 = 10^{-12}	pico	p

Examples of the metric measures and weights and their equivalents are given in Tables 1 and 2.

Use the centigrade scale whenever practical, rather than the Fahrenheit, to indicate temperature in research reports.

TABLE 1. *Metric measures and weights with common equivalents*

		Length		
Myriameter	10,000 meters		6.213	miles
Kilometer*	1,000 meters		0.621	mile
Hectometer	100 meters		109.3	yards
Dekameter	10 meters		10.93	yards
Meter*	1 meter		3.28	feet
Decimeter	0.1 meter		3.937	inches
Centimeter*	0.01 meter		0.393	inch
Millimeter*	0.001 meter		0.039	inch
Micron*	0.000 001 meter		0.000 039	inch
		Surface		
Hectare	10,000 square meters			2.471 acres
Are	100 square meters	119.6 square yards		0.025 acre
		Capacity		
Kiloliter	1,000 liters	1 cubic meter	1.308 cubic yards	264.18 gallons
Hectoliter	100 liters	0.1 cubic meter	2.838 bushels	26.42 gallons
Dekaliter	10 liters	0.01 cubic meter	1.135 pecks	2.64 gallons
Liter*	1 liter	0.001 cubic meter	61.02 cubic inches	1.06 quarts
Deciliter	0.1 liter	0.000 1 cubic meter	6.10 cubic inches	0.18 quart
Centiliter	0.01 liter	0.000 01 cubic meter	0.61 cubic inch	0.33 ounce
Milliliter*	0.001 liter	0.000 001 cubic meter (1.0 cubic centimeter)	0.06 cubic inch	0.27 dram
		Weight		
Metric ton*	1,000 kilograms	1 cubic meter water 4 C		2,204.6 pounds
Myriagram	10 000 grams	1 dekaliter water 4 C		22.04 pounds
Kilogram	1,000 grams	1 liter water, 4 C		2.20 pounds
Hectogram	100 grams	1 deciliter water 4 C		3.52 ounces
Dekagram	10 grams	10 cubic centimeters water 4 C		0.35 ounce
Gram	1 gram	1 cubic centimeter water 4 C		15.43 grains
Decigram	0.1 gram	0.1 cubic centimeter water 4 C		1.54 grains
Centigram	0.01 gram	10 cubic millimeters water 4 C		0.15 grain
Milligram	0.001 gram	1 cubic millimeter water 4 C		0.01 grain
Microgram	0.000 001 gram			0.000 015 grain

* Most commonly used names.

GEOGRAPHIC AND GEOLOGIC NAMES

For geographic names refer to the *U. S. Government Printing Office Style Manual*, *Lippincott Gazetteer of the World*, *Rand McNally World Atlas*, the latest maps published by federal or state agencies, or lists published by the Board on Geographic Names, Office of Geography, Department of the Interior.

TABLE 2. *Common measures and weights with metric equivalents*

Inch	2.54 cm	Quart, liquid, US (32 oz)	0.946 liter
Foot	30.48 cm	Quart, dry US (2 pints)	1.101 liters
Yard	0.914 m	Quart, imperial (40 oz)	1.136 liters
Fathom (2 yards)	1.829 m	Gallon, US (4 quarts)	3.785 liters
Rod (5½ yards)	*5.029 m*	*Gallon, imperial*	*4.546 liters*
Furlong (220 yards)	201.16 m	Peck, dry US (8 quarts)	8.809 liters
Mile, statute (1,760 yards)	1.609 km	Peck, dry imperial	9.092 liters
Mile, nautical (2,026 yards)	1.852 km	Bushel, dry US (4 pecks)	35.24 liters
Square inch	6.452 cm	Bushel, imperial	36.37 liters
Square foot	0.093 m²	Pound, avdp (16 oz)	453.592 g
Square yard	0.836 m²	Pound, troy (12 oz)	373.24 g
Square rod	25.29 m²	Ounce, avdp (16 drams)	28.35 g
Square mile (640 acres)	2.59 km	Ounce, troy (480 grains)	31.103 g
Acre	40.468 ares	Dram, avdp	1.77 g
Cubic inch	16.387 cm³	Grain, troy	0.065 g
Cubic foot (1,728 cubic inches)	0.028 m³	Carat (precious stones)	0.200 g
Cubic yard (27 cubic feet)	0.7646 m³	Ton, metric (2,204.6 pounds)	10⁶ g
Board foot (144 cubic inches)	*0.0024 m³*	*Ton, long (2,240 pounds)*	*1.016 metric ton*
Cord (128 cubic feet)	3.625 m	Ton, short (2,000 pounds)	0.907 metric ton
Pint, liquid, US (16 oz)	0.473 liter		

Do not abbreviate divisions of the earth's surface (Arctic Circle, South Pole, etc.), continents (Africa, Asia, South America, etc.) and countries (North Vietnam, South Korea), regions (Sahara, Middle West, Orient), islands, oceans, seas, lakes and rivers, and mountains (Pyrenees, Himalayas, etc.). Names of cities should be as they are spelled in the country. Certain cities and geographic regions of biological significance, however, have had English spellings for many years and these have also become conventional names. Use them. A few examples with the official or local name in parentheses are

Alexandria (El Iskandariya) Egypt
Archangel (Arkhangel'sk) USSR
Athens (Athinai) Greece
Bangkok (Krung Thep) Thailand
Beirut (Beyrouth) Lebanon
Belgrade (Beograd) Yugoslavia
Bogor (Buitenzorg) Indonesia
Breslau (Wroclaw) Poland
Bucharest (Bucuresti) Romania
Cairo (El Qahira) Egypt
Canton (Kwangchow) China
Changchun (Hsinking) China
Copenhagen (København) Denmark
Corsica (Corse)
Crimea (Krym) Peninsula USSR
Damascus (Damas) Syria
Danzig (Gdansk) Poland
Djakarta (Batavia) Indonesia
Finland (Suomi)
Florence (Firenze) Italy
Hankow (Wuhan) China
Havana (Habana) Cuba
Ireland (Eire)
Kanpur (Cawnpore) India
Keshish (Olympus) Mountain Turkey
Kiev (Kiyev) USSR
Lanchow (Kadan) China
Lisbon (Lisboa) Portugal
Moscow (Moskva) USSR

Mukden (Shenyang) China
Munich (München) Germany
Nam (Tengri) Lake China
Naples (Napoli) Italy
Peking (Peiping) China
Prague (Praha) Czechoslovakia
Rome (Roma) Italy
Salonika (Thessaloniki) Greece
Seoul (Kyongsong) Korea
Sofia (Sofiya) Bulgaria
Surabaja (Soerabaja) Indonesia
Taipei (Taihoku) Formosa
Turku (Åbo) Finland
Venice (Venezia) Italy
Vienna (Wien) Austria
Warsaw (Warszawa) Poland
Yangtze River (Ch ang Chiang) China
Zhdanov (Mariupol) USSR

United States and foreign geological names and terms should be used in accordance with the stratigraphic records of the Geologic Names Committee United States Geological Survey Table 3 shows the accepted names (1957) for eras systems or periods, and series or epochs

TABLE 3. *Major stratigraphic and geological time divisions in use by the U S Geological Survey*

Era	System or Period		Series or Epoch	Approximate Time Boundaries in Millions of Years
	Quaternary	(Q)	Recent	
			Pleistocene	1
Cenozoic	Tertiary	(T)	Pliocene	10
			Miocene	25
			Oligocene	40
			Eocene	60
			Paleocene	
Mesozoic	Cretaceous	(K)	Upper Lower	125
	Jurassic	(J)	Upper Middle Lower	150
	Triassic	(TR)	Upper Middle Lower	180
Paleozoic	Permian	(P)		203
	Pennsylvanian	(P*)	Upper Middle Lower	
	Mississippian	(M*)	Upper Lower	255
	Devonian	(D)	Upper Middle Lower	315
	Silurian	(S)	Upper Middle Lower	350
	Ordovician	(O)	Upper Middle Lower	430
	Cambrian	(C)	Upper Middle Lower	510
Precambrian		(pC)	Upper Middle Lower	3 000

The letter symbol C is used to designate Carboniferous systems in regions where Pennsylvanian and Mississippian systems are not differentiated.

The standard letter symbols used on geologic maps are given in parentheses

Minor stratigraphic units and words known locally, are not abbreviated or capitalized. Examples formation dome coal beds slate fault, East Texas oil field currelly vein Names of the great soil groups are capitalized Alpine Meadow Bog Chernozem Desert Podzol (ashlike) Prairie Tundra

ABBREVIATIONS AND SYMBOLS

Abbreviations consist of one or more letters (rarely more than four) to which words and phrases have been reduced by contraction or omission To avoid confusion use few abbreviations and *do not form new ones*

Short words for units of measurement such as acre cent chain day inch liter mile rod, ton and week should ordinarily be spelled out. When in doubt, spell it out

The same abbreviation is used for both singular and plural as 1 mm and 3 mm " but when used in a sentence the verbs should agree with the quantity, thus 1 mm is ' and 3 mm are Letters in abbreviations such as ATP are not spaced Omit periods after letters except where confusion might result or after abbreviation of certain Latin words. Thus no 7" for number seven Fig for figure et al for *et alii* N Y ' for New York but 3.30 PM for afternoon

Do not abbreviate names of countries, except USA and USSR. In the text, abbreviate state names (except Alaska Hawaii Idaho Iowa Maine Ohio Texas and Utah) and district names immediately after any geographic term Rochester N Y Cambridge Mass México D F Washington D C Do not abbreviate English translations of geographic names of foreign language origin (*see* p 21) Abbreviations for geologic terms should conform to those proposed by the Geologic Names Committee, United States Geological Survey (*see* p 21)

Since confusion has arisen over certain abbreviations the following words and terms should be spelled out cocarboxylase dinitrophenol enzymic activity hydrocortisone naphthaleneacetic acid nicotinamide thiamine thyroxine tricarboxylic acid cycle and the members thereof trichloroacetic acid pantothenic acid and its salts pteroylglutamate pyridoxal pyridoxamine deoxypyridoxamine amino acids peptides carbohydrates and all other words and phrases not widely used in several branches of science Avoid all jargon

Do not use abbreviations in the title of a paper because titles are often

translated into foreign languages and undefined or uncommon abbreviations may lead to confusion.

Use abbreviations sparingly in the text of a paper or abstract and only if they are of advantage to the reader. Generally accepted abbreviations may be used, providing they are clear or are defined when first employed. Ordinarily a sentence should not begin with an abbreviation or a numeral. Abbreviate terms denoting units of weight and measure in the text only when preceded by numerals: thus "gram," "meter," "milliliter," "molar," but "10 g," "100 m," "25 ml," and "0.1 M." Use the decimal system for units of concentration, etc.: thus 0.1 M, not M/10. Conventional signs and symbols for certain abbreviations are permitted in the text: thus the slant line (/) for "per" (if only one is required, see p. 16) and % with an Arabic numeral for "per cent." Do not use milligrams per cent; use instead g/ml, g/100 ml, g/liter, etc.

Common abbreviations may be used in the headings of tables, maps, specifications, and figures, but should be defined in the nearby text, the legend, or footnote.

Spell out scientific names of organisms in the titles of papers and abstracts. In the text spell out generic names when first used, but they may be abbreviated to their first letter afterwards when used in binary combination (botany, bacteriology) or binomen (zoology), and no confusion results. Never abbreviate generic names when used alone: thus *Acarus* and *Zea*, not *A.* and *Z.* For abbreviations of a new genus (*novum genus*), new species (*nova species*), and new variety (*nova varietas*) the Latin "gen. n.," "sp. n.," and "var. n." are preferable to the English forms "n. gen.," "n. sp.," and "n. var.," because the name of a new taxon is Latin (and a Latin synopsis of a new plant taxon must be furnished). And the Latin is recommended for *nomen conservandum* (plural, *nomina conservanda*), *nomen nudum* (plural, *nomina nuda*), and *nomen rejiciendum* (plural, *nomina rejicienda*).

Do not abbreviate names of enzymes. Avoid such usage as ATPase, RNase, and DNase or DNAase for adenosine triphosphatase, ribonuclease, and deoxyribonuclease.

Many special abbreviations are in common use. For example, standard definitions and symbols used in respiratory physiology have been published (Federation Proc. 9: 602–603. 1950); terms used in radiation biology have been considered for adoption by international groups, and other abbreviations may be found in dictionaries. The following abbreviations and symbols are acceptable. Most are taken from the American Standards Association *Abbreviations for Scientific and Engineering Terms* (Bulletin Y1. Z10.1-1941).

about (*circa*)	ca.
absolute	abs
absorbancy (Spectrophotometric unit equal to $\log_{10}$ (1/T) or $\log_{10}$ (I_0/I) where T = transmittancy I_0 = intensity of radiation entering medium and I = intensity after traversing the medium. Transmittancy refers to the properties of the solute the optical properties of the cuvette and solvent having been eliminated by suitable control Transmittance and absorbance refer to the optical properties of the entire assembly of cuvette solvent and solute) *See also* molecular extinction coefficient.	*A*
acetic acid 2 4-dichlorophenoxy	2 4 D
acre	*spell out*
adenosine diphosphate	ADP
adenosine monophosphate needed for contrast of 2 and 3 phosphates = 2′ AMP 3 AMP	AMP
adenosine triphosphatase (enzyme)	*spell out*
adenosine triphosphate	ATP
ad libitum (as desired)	ad lib
adrenocorticotropin	ACTH
afternoon (*post meridiem*)	PM
against (*versus*)	vs
alternating-current (adj)	a-c
altitude	alt
amount	amt
ampere(s)	amp
ampere-hour	amp-hr
and elsewhere (*et alibi*)	et al
and others (*et alii*)	et al
and the rest (*et cetera*)	etc
Ångstrom (unit)	A

anno Domini	A.D
ante meridiem (before noon)	AM
antilogarithm	antilog
aperture ratio 16	*f*/16
approximate (as adj) (or use about ")	approx
aqueous	aq
are (100 m^2)	*spell out*
as desired (*ad libitum*)	ad lib.
atmosphere(s)	atm
atomic weight	at wt
audio-frequency (adj)	af
average (abbreviate in tables only)	avg
avoirdupois	avdp
barrel(s)	bl bbl
basal metabolic rate	BMR
Baumé	Bé
before noon (*ante meridiem*)	AM
billion	*see* giga
biochemical oxygen demand	BOD
board feet (feet board measure)	fbm
body weight	body wt
boiling point	bp
British antilewisite (2 3-dimercapto-1-propanol)	BAL
British thermal unit(s)	BTU
bushel(s)	bu
calorie(s) (small gram calorie)	cal
Calorie(s) (large, kilogram calorie)	kcal
cent	*spell out*
centi (prefix 10^{-2})	c
centigrade (omit degree symbol) (with numeral)	C
centigram(s)	cg
centimeter(s)	cm
centimeter square	cm^2
centimeter-gram-second (system)	cgs
central nervous system	CNS
chemically pure	cp
circa (about)	ca.
coefficient	coef
coenzyme A	CoA

coenzyme A, and its acyl derivatives	Acyl-CoA
compare (confer) (avoid use of abbreviation)	cf
concentrate	conc
concentrated	concd
concentration	concn
conductivity	cond
configuration	D- L- DL-
constant	const
corrected (in melting point determinations)	cor
cosine	cos
coulomb	coul
counts per minute	count/min
counts per second	count/sec
crossed with (genetics)	×
cubic centimeter(s)	cm cc
cubic foot	ft
cubic kilometer	km
cubic meter(s)	m
cubic micron( )	μ
cubic millimeter(s)	mm
cubic yard	yd³
curie (3 7 × 10¹⁰ disintegration/sec)	c
cycles per minute	cycle/min
cycles per second	cycle/sec
day	*spell out*
DDT *see* ethane	
deci (prefix 10⁻¹)	d
decibel	db

Use small capital letters only for optically active compounds and their racemic forms when the compounds (carbohydrates amino acids, and a few other substances) can be correlated *sterically* with glyceraldehyde or serine. I other cases *d* and *l* *dextro-* and *levo-* or (+) and (−) are used t denote direction of optical rotation Racemic compounds are designated by *dl* (±) or the italicized word *racemic* (as racemic-galactose) DL- is used only when the prefix D- or L- can be properly applied in naming the optically active isomer

decigram (0.1 g)	dg
decimeter (0.1 m)	dm
decompose (melting point)	decomp dec
degree centigrade (omit degree symbol)	C
degree Fahrenheit (omit degree symbol)	F
degree Kelvin (omit degree symbol)	K
degree (space)	deg or
degrees of freedom (statistics)	df (in tables)
deka (prefix 10)	dk
density (as d_{20} specific gravity at 13 C referred to water at 4 C d^{20}_{20} at 20 C referred t water at same temperature)	d
deoxyribonuclease	*spell out*
deoxyribonucleic acid	DNA
dextrorotatory (*see* configuration)	*d dextro-* (+)-
diameter	diam
diameter at breast height	dbh
2 4-dichlorophenoxyacetic acid	2 4-D
diffusion coefficient (usually given in cm²/sec)	D D_{20} w
diphosphopyridine nucleotide	DPN
diphosphopyridine nucleotide reduced form of (do not use PNH for reduced pyridine nucleotide since this abbreviation has been used for several other terms)	DPNH
direct current (adj)	d-c
dissociation constant, negative log of	pK
dollar	*spell out* or $ in tables (with numerals)
dozen	doz
dram	dr

about (*circa*)	ca.
absolute	abs
absorbancy (Spectrophotometric unit equal to $\log_{10}$ (1/T) or $\log_{10}$ (I_0/I) where T = transmittancy, I_0 = intensity of radiation entering medium and I = intensity after traversing the medium. Transmittancy refers to the properties of the solute, the optical properties of the cuvette and solvent having been eliminated by suitable control. Transmittance and absorbance refer to the optical properties of the entire assembly of cuvette, solvent and solute.) *See also* molecular extinction coefficient.	*A*
acetic acid, 2,4-dichlorophenoxy	*2,4-D*
acre	*spell out*
adenosine diphosphate	ADP
adenosine monophosphate (needed for contrast of 2'- and 3'-phosphates = 2' AMP, 3' AMP)	AMP
adenosine triphosphatase (enzyme)	*spell out*
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ad libitum (as desired)	ad lib
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afternoon (*post meridiem*)	PM
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altitude	alt
amount	*amt*
ampere(s)	amp
ampere-hour	amp-hr
and elsewhere (*et alibi*)	et al
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and the rest (*et cetera*)	etc
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antilogarithm	antilog
aperture ratio 16	*f*/16
approximate (as adj) (or use "about")	approx
aqueous	aq
are (100 m²)	*spell out*
as desired (*ad libitum*)	ad lib.
atmosphere(s)	atm
atomic weight	at wt
audio frequency (adj)	af
average (abbreviate in tables only)	avg
avoirdupois	avdp
barrel(s)	bl, bbl
basal metabolic rate	BMR
Baumé	Bé
before noon (*ante meridiem*)	AM
billion	*see* giga
biochemical oxygen demand	*BOD*
board feet (feet board measure)	fbm
body weight	body wt
boiling point	*bp*
British antilewisite (2,3-dimercapto-1-propanol)	BAL
British thermal unit(s)	BTU
bushel(s)	*bu*
calorie(s) (small, gram calorie)	cal
Calorie(s) (large, kilogram *calorie*)	kcal
cent	*spell out*
centi (prefix, 10^{-2})	c
centigrade (omit degree symbol) (*with numeral*)	C
centigram(*s*)	cg
centimeter(s)	cm
centimeter, square	cm^2
centimeter-gram-second (system)	cgs
central nervous system	CNS
chemically pure	cp
circa (about)	ca
coefficient	coef
coenzyme A	CoA

coenzyme A, and its acyl derivatives	Acyl-CoA
compare (confer) (avoid use of abbreviation)	cf
concentrate	conc
concentrated	concd
concentration	concn
conductivity	cond
configuration	D, L, DL-
constant	const
corrected (in melting point determinations)	cor
cosine	cos
coulomb	coul
counts per minute	count/min
counts per second	count/sec
crossed with (genetics)	×
cubic centimeter(s)	cm, cc
cubic foot	ft
cubic kilometer	km
cubic meter(s)	m
cubic micron(s)	μ
cubic millimeter(s)	mm
cubic yard	yd
curie (3.7 × 10^{10} disintegration/sec)	c
cycles per minute	cycle/min
cycles per second	cycle/sec
day	*spell out*
DDT, *see* ethane	
deci (prefix, 10^{-1})	d
decibel	db

Use small capital letters only for optically active compounds and their racemic forms when the compounds (carbohydrates, amino acids, and a few other substances) can be correlated sterically with glyceraldehyde or serine. In other cases *d* and *l* (*dextro-* and *levo-*) or (+) and (−) are used to denote direction of optical rotation. Racemic compounds are designated by *dl*, (±), or the italicized word *racemic* (as racemic-galactose). DL- is used only when the prefix D- or L- can be properly applied in naming the optically active isomer.

decigram (0.1 g)	dg
decimeter (0.1 m)	dm
decompose (melting point)	decomp, dec
degree centigrade (omit degree symbol)	C
degree Fahrenheit (omit degree symbol)	F
degree Kelvin (omit degree symbol)	K
degree (space)	deg or °
degrees of freedom (statistics)	df (in tables)
deka (prefix, 10)	dk
density (as d_{15}, specific gravity at 15 C referred to water at 4 C; d_{20}^{20} at 20 C referred to water at same temperature)	d
deoxyribonuclease	*spell out*
deoxyribonucleic acid	DNA
dextrorotatory (see configuration)	*d*, *dextro-*, (+)-
diameter	diam
diameter at breast height	dbh
2,4-dichlorophenoxyacetic acid	2,4-D
diffusion coefficient (usually given in cm²/sec)	D, $D_{20,w}$
diphosphopyridine nucleotide	DPN
diphosphopyridine nucleotide, reduced form of (do not use PNH for reduced pyridine nucleotide since this abbreviation has been used for several other terms)	DPNH
direct current (adj)	d-c
dissociation constant, negative log of	pK'
dollar	*spell out* or $ in tables (with numerals)
dozen	doz
dram	dr

dry weight	dry wt
East	E
effective dose median	ED_{50}
electrocardiogram	ECG
electrode potential	*E*
electrode potential standard	E_0
electrode potential standard at constant pH	E_0
electroencephalogram	EEG
electromotive force	emf
electron volt(s)	ev
erg	*spell out*
et alibi (and elsewhere)	et al
et alii (and others)	et al
et cetera (and the rest)	etc.
ethane 1 1 1-trichloro 2 2-bis (*p*-chlorophenyl)	DDT
ethylenediamine-tetraacetate	EDTA (*not* versene)
exempli gratia (for example)	e g
extinction ($\log I_0/I$)	E
Fahrenheit (omit degree symbol) (with numeral)	F
farad	*spell out*
female	♀
figure (illustration)	Fig
filial generations (genetics)	F_1 F_2 F_3 etc
flavin adenine dinucleotide	FAD
flavin adenine dinucleotide reduced form of	$FADH_2$
focal length	*f/* (with numeral)
foot	ft (with numeral)
foot candle	ft-c
for example (*exempli gratia*)	e g
forenoon	AM
forma (taxonomy only)	f
freezing point	fp
frequency modulation	FM
fusion point (*see* mp)	fup
gallon(s)	gal
gamma (*see* microgram)	
generations filial (genetics)	F F_1, F_2, etc
genus new	gen n
giga (prefix, 10^9)	G
glutathione oxidized	GSSG
glutathione reduced	GSH
grain(s)	gr (with numeral)
gram(s)	g
gram calorie	cal
gram molecule	g mole (*or* mole)
gravity centrifugal	*g*
hecto (prefix 10^2)	h
hectometer (100 m)	hm
hemoglobin (*thus* HbO_2 oxygenated hemoglobin)	Hb
horsepower	hp
hour(s)	hr (with numeral)
hundredweight	cwt
hydrogen ion concentration negative log of	pH
plural	pH values
ibidem (in the same place)	ibid
id est (that is)	i.e.
inch	*spell out* (*or* in with numerals)
infective dose median (infect 50% of inoculated group)	ID_{50}
international unit	IU
intramuscular intramuscularly	im
intraperitoneal intraperitoneally	ip
intravenous intravenously (do not confuse with Roman IV)	iv
Kelvin (scale in which zero is −273 1 C) (omit degree symbol) (with numeral)	K
kilo- (prefix, 10^3)	k
kilocalorie(s)	kcal
kilocycle(s)	kc
kilocycles per second	kc/sec
kiloelectron volt	kev
kilogram(s)	kg
kiloliter(s)	kl
kilometer(s)	km
kiloröntgen(s)	kr
kilovolt(s)	kv
kilowatt(s)	kw

Lambert	L
latitude	lat (with numeral)
lethal dose median (lethal for 50% of inoculated group)	LD_{50}
levorotatory (see also configuration)	*l*, levo-, (−)-
liter(s)	*spell out*
loco citato (in the place cited) *avoid abbreviation*	loc. cit.
logarithm (common base 10) in formulas	log, log_{10}
logarithm (natural base *e*) in formulas	ln, log_e
longitude	long (with numeral)
magnified by	×
male	♂
maximum	max
mega (prefix 10^6)	M
melting point	mp
metabolic rate	MR
meter(s)	m
meter(s) cubic	m^3
meter(s) square	m^2
mho (reciprocal ohm)	*spell out*
micro- (prefix, 10^{-6})	μ
microcurie(s)	μc
microfarad	μf
microgram (do not use gamma, γ)	μg
microliter (do not use lambda, λ)	μl
micromicron (10^{-6} mm)	μμ
micromolar (unit of concn)	μM
micromole (unit of mass)	μmole
micron(s) (10^{-3} mm)	μ
microvolt	μv
microwatt	μw
mile(s)	*spell out*
miles per hour	mph
milli (prefix, 10^{-9})	m
milliampere(s)	ma
millicurie(s)	mc
milliequivalent(s)	meq mEq
milligram(s)	mg
milligrams per cent (mg%)	never use
milliliter( )	ml
millimeter(s)	mm
millimeter(s) square	mm^2
millimicron (10^{-6} mm)	mμ
millimolar (unit of concn)	mM
millimole (unit of mass)	mmole
million electron volts	Mev
millivolt(s)	mv
millivolt-second	mv-sec
minimum or minute(s)	min
minimum lethal dose	MLD
minute(s) or minimum	min
minute (angular measure)	′
molar (mole per liter)	M
mole (a gram molecule)	mole
molecular extinction coefficient (*ε* = *AM*/*bc* where *A* is absorbancy *M* is molecular weight, *b* is cell length in cm and *c* the concentration in g per liter)	*ε*
molecular weight	mol wt
month	*spell out*
myria- (prefix, 10^4)	my
nano- (prefix, 10^{-9})	n
new species	sp. n.
nonprotein nitrogen	NPN
normal (concn, 0.1 N)	N
normal (in trivial names of organic compounds)	*n*-
normal temperature and pressure	NTP
North, Northwest	N, NW
number (numero) in enumeration	no.
numerical aperture in microscopy	NA
ohm	*spell out*
opere citato (in the work cited) *avoid abbreviation*	op. cit.
optical density	OD (with numeral)
optical rotation: Specific optical rotation (with concn [illegible] w/v) thus [α] = $[\alpha]^{20}_{5461}$, etc. Molecular optical rotation (=[α] × mol wt/10) thus $[M]^{20}_{D}$, $[M]^{20}_{5461}$, etc.	

optimal (adj) optimum (noun)	opt
ounce	oz
page(s)	p (with numeral)
paralysis median	PD_{50}
parts per million	ppm
per cent	% (with numeral)
pico- (prefix 10^{-12})	p
post meridiem (afternoon)	PM
precipitate (in tables)	ppt
preparation (in tables)	prepn
probability (that an event is due to chance alone)	*P*
pound(s) (*libra*)	lb
pounds per square inch	lb/in^2 psi (with numeral)
qualitative (in tables)	qual
quantitative (in tables)	quant
radiation ionizing absorbed dose (100 ergs/g of irradiated material) Use in place of (rep) röntgen equivalent physical	rad
radiation relative biological effectiveness (one type of radiation compared to another)	RBE
radio-frequency	rf
red blood cells	RBC
refractive index (at stated temperature and wavelength thus $[n]^{20}$ for 20 C and sodium light)	*n*
respiratory quotient	RQ
reticuloendothelial system	RES
revolutions per minute (use *g* where possible)	rev/min
ribonuclease (enzyme)	*spell out*
ribonucleic acid	RNA
röntgen (unit of exposure dose of X or γ-radiation)	r
röntgen equivalent man (rad × RBE = rem)	rem
salinity in per thousand	‰
second(s) time	sec
sedimentation coefficient corrected to 20 C in water (S_{20} may be used if not ambiguous)	$S_{20,w}$
see (do not use cf)	*spell out*
sine	sin
South Southwest	S SW
species (taxonomy only)	sp
species new	*sp. n.*
specific gravity	sp gr
spectrophotometric units *see* absorbancy *and* molecular extinction coefficient	
square	sq
square centimeter	cm^2
square foot	ft^2
square meter	m^2
square millimeter	mm^2
standard deviation	SD
standard error	SE
subcutaneous	SC
sulfhydryl or thiol group	SH
tangent	tan
temperature	temp
tera (prefix 10^{12})	T
that is (*id est*)	i.e.
ton	*spell out* (or T with numeral)
trichloroacetic acid (TCA is not acceptable)	*spell out*
1,1,1-trichloro-2,2-di-(*p*-chlorophenyl)-ethane	DDT
triphosphopyridine nucleotide	TPN
triphosphopyridine nucleotide reduced form of	TPNH
tris buffer (give chemical name when first mentioned) [tris (hydroxymethyl) aminomethane or 2-amino-2 (hydroxymethyl) 1,3-propanediol]	tris
ultraviolet	UV (with numeral in table)
variety(ies) (in taxonomy only)	var
versus (against)	vs
viscosity (symbol)	(eta) η

volt	v
volume	vol (with numeral in table)
volume/volume (concn)	v/v
watt	w
wavelength (symbol)	(lambda) λ
week(s)	*spell out* (or wk with numeral in table)
weight	wt
weight/volume (concn)	w/v
West	W
X-irradiation	
X ray (noun)	
X ray (adj)	
yard(s)	*spell out* (or yd with numeral in table)
year(s)	*spell out* (or yr with numeral in table)

Greek Alphabet

Greek letters are frequently used as symbols and in mathematical formulas. They should be clearly drawn by hand if not available on the typewriter. When confusion may arise, clarify by spelling in margin in pencil. Since the capital Greek letters A, B, E, Z, H, I, K, M, N, O, P, T and X are identical with certain English letters, try to avoid them as symbols.

Name of Letter	*Capital*	*Small*	*Latin and English Equivalent*
alpha	A	α	a
beta	B	β	b
gamma	Γ	γ	g (or n)
delta	Δ	δ	d
epsilon	E		e
zeta	Z	ζ	z
eta	H		e
theta	Θ	θ	th (or t)
iota	I		i
kappa	K		c (or k)
lambda	Λ	λ	l
mu	M	μ	m
nu	N		n
xi	Ξ	ξ	
omicron	O		o
pi	Π	π	p
rho	P	ρ	r (or rh)
sigma	Σ		s
tau	T		t
upsilon	Υ		y (or u)
phi	Φ	φ	ph (or f)
chi	X	χ	ch
psi	Ψ		ps
omega	Ω	ω	o

optimal (*adj*) optimum (noun)	opt
ounce	oz
page(s)	p (with numeral)
paralysis median	PD_{50}
parts per million	ppm
per cent	% (with numeral)
pico- (prefix 10^{-12})	p
post meridiem (afternoon)	pm
precipitate (in tables)	*ppt*
preparation (in tables)	prepn
probability (that an event is due to chance alone)	*P*
pound(s) (*libra*)	lb
pounds per square inch	lb/in² psi (with numeral)
qualitative (in tables)	qual
quantitative (in tables)	quant
radiation ionizing absorbed dose (100 ergs/g of irradiated material) Use in place of (rep) rontgen equivalent physical	rad
radiation, relative biological effectiveness (one type of radiation compared to another)	RBE
radio-frequency	rf
red blood cells	RBC
refractive index (at stated temperature and wave length, thus $[n]^{20}_{D}$ for 20 C and sodium light)	*n*
respiratory quotient	RQ
reticuloendothelial system	*RES*
revolutions per minute (*use g* where possible)	rev/min
ribonuclease (enzyme)	*spell out*
ribonucleic acid	RNA
röntgen (unit of exposure dose of X or γ radiation)	r
röntgen equivalent man (rad × RBE = rem)	rem
salinity in per thousand	‰
second(s) time	sec
sedimentation coefficient corrected to 20 C in water (S_{20} may be used if not ambiguous)	$S_{20,w}$
see (do not use cf)	*spell out*
sine	sin
South Southwest	S SW
species (taxonomy only)	sp
species new	sp n.
specific gravity	sp gr
spectrophotometric units *see absorbancy and molecular extinction coefficient*	
square	sq
square centimeter	cm²
square foot	ft²
square meter	m²
square millimeter	mm²
standard deviation	SD
standard error	SE
subcutaneous	sc
sulfhydryl or thiol group	SH
tangent	tan
temperature	temp
tera (prefix 10^{12})	T
that is (*id est*)	i e
ton	*spell out* (or T with numeral)
trichloroacetic acid (TCA is not acceptable)	*spell out*
1 1 1 trichloro-2 2 -di (*p*-chlorophenyl)-ethane	*DDT*
triphosphopyridine nucleotide	TPN
triphosphopyridine nucleotide reduced form of	TPNH
tris buffer (give chemical name when first mentioned) [tris (hydroxy methyl) aminomethane or 2-amino-2 (hydroxy methyl) 1 3 propanediol]	tris
ultraviolet	UV (with numeral in table)
variety(ies) (in taxonomy only)	var
versus (against)	*vs*
viscosity (symbol)	(eta) η

II. PREPARATION OF COPY

PAPER

Use good white paper 8½ × 11 inches or 8 × 10½ inches, neither glazed nor too rough for erasures and corrections in ink. For the ribbon copy use 16-pound bond with rag content; for the carbons use bond or a thin paper of good quality.

TYPING

Keep type faces clean. Use a black ribbon neither so worn that the typing is faint nor so new that the impression smears. Discard carbon paper before it fails.

Make at least two carbon copies corresponding in paging and in all insertions and corrections. Submit one copy with the original to expedite editorial review. Furnish two sets of illustrations (one may be a facsimile). Keep one copy of the manuscript and one set of illustrations.

Start a new page for each of the following sections, with appropriate headings. Arrange the copy (see Paging, below) in this order: (1) title, by-line, running head, name and address for mailing; (2) abstract; (3) text, in the natural sequence of its parts; (4) acknowledgments; (5) references to literature; (6) footnotes; (7) tables; (8) legends for figures; and (9) the figures. If the journal to which you are submitting the manuscript does not publish simultaneous abstracts, include a duplicate abstract for *Biological Abstracts*; do not number the page (see p. 35).

Type on one side of the paper only; keep lines fairly uniform in length, and leave margins of 1 to 1½ inches for the editor's marks and queries. Avoid dividing a word at the end of a line; if division is necessary, check a dictionary for the proper dividing point. Never divide a word at the end of a page.

Double-space everything—text, quotations, footnotes, tables and table headings, legends, references to literature—and use even greater spacing where helpful (particularly around equations and formulas).

Type the long dash (em) as two unspaced hyphens.

Check the entire manuscript for typographical errors with particular attention to quotations, citations, technical terms, and names of persons and places. Check the list of references against original sources for (1) wording, (2) spelling, (3) capitalization, (4) italics, (5) diacritical marks, (6) abbreviation, (7) page and volume numbers and dates. Then

Diacritical Marks

Diacritical marks are signs symbols or points attached to a letter to distinguish it phonetically Such marks as the grave accent (le congrès) acute accent (beauté) cedilla (garçon), inverted cedilla (Dąbrowa) circumflex (bâtir) inverted circumflex (Čechoslovaca) dieresis (dots over second of two consecutive vowels as in preëminence) or umlaut (short perpendicular marks over certain vowels in German indicating deletion of a second vowel, e g., für Anfänger *for* fuer Anfaenger) macron (kyūshū) slash or stød (used in Danish and Norwegian words as Grønland) soft sign (Krasil nikov) superior dot (Skarżysko), stroke (in certain Polish words, as spółka) tilde (Español) kratkaya or breve (Omskiĭ) and others should be used as they are in the language of the country Take care to use them correctly Diacritical marks are not used in Anglicized words of foreign origin or in place names of foreign origin when applied to places in the United States

LITERATURE CITED SECTION I

Baker S 1956 Scholarly style or the lack thereof Am. Assoc Univ Professors Bull 42: 464–470

Kealing R. V 1958 Crimes in scientific writing Turtox News 36: 274–276

Riker A J 1946 The preparation of manuscripts for Phytopathology Phytopathology 36: 953–977

BY LINE

The by-line comprises two elements the author(s) without *by* and the institution(s) where the investigation was made, without the prefix *from the*. The author should always type his name as he customarily writes it to aid the indexer and to avoid confusion. Omit titles and degrees. Name the department and institution, and spell out city and state. When co-authors represent different institutions name the institutions in order of authorship thus

J Quentin Doe and R. Roe
Department of Biology Blank College Pine City Illinois
and
Department of Zoology White University Chicago Illinois

Naming an institution in the by-line implies that the research was done there If the research was conducted in two places, name both. If you accept another position, do not credit the new institution for work completed before the move But do acknowledge any assistance from the new institution.

Identify an article based upon a dissertation or thesis in a footnote by the form prescribed by the institution.

ABSTRACT

The abstract summarizes the contents and conclusions of the paper points to new information in the paper and indicates the relevance of the work. An abstract serves two functions when accompanying the complete article, it is a useful preview published alone it provides for wide acquaintance with the work and with its source

The term "synopsis" has been adopted by the Royal Society of London and by the UNESCO International Conference on Science Abstracting, 1949 to describe an author's abstract published with the paper A summary of the recommendations follows (UNESCO International Council of Scientific Unions Abstracting Board)

Style

Assume that your readers have some knowledge of the subject but have not read the paper The abstract should be completely self-explanatory and intelligible in itself Use complete sentences (rather than a mere list of headings) and omit jargon. Use standard rather than proprietary terms and scientific nomenclature. Avoid abbreviations

collate the references in the text with this verified list Check the numerical data in the text and tables after final typing

PAGING

Number all pages consecutively in the upper right-hand corner Never use a number and letter (e g 3A, 3B) for paging such pages may be lost without indication that they are missing Include a duplicate abstract on an unnumbered page, if the journal considering the manuscript does not publish simultaneous abstracts (see p 35) Never staple or bind the manuscript.

CORRECTIONS AND INSERTIONS

Type brief corrections, or letter them legibly in ink above the line concerned Do not write on margins or below the line or attach slips of paper (flyers) to the pages. Retype any page needing lengthy insertions even if the next page is then only partly filled Mark unfilled pages when not ending a section, with a diagonal line below the text to indicate that this is not the end *If you insert pages, renumber consecutively* on the original and all copies (*see* Paging)

TITLE

Phrase the title specifically to identify the content of the article. Abstracting and indexing journals plead for short specific titles Include the nature of the study the organisms and where appropriate the technical approach (X ray chromatography histochemistry electron microscopy etc.) Clarity and conciseness are essential for indexing abstracting and retrieval Some journals permit no more than 90 characters and spaces others, no more than 10 words Avoid unnecessary *the s* and redundant openings such as *Investigations on The nature of Studies of* and *Contributions to* Do not identify a publication as number one (Electron microscopy of cardiac muscle I Mitochondria in human cardiac muscle) unless a second paper in the series is assured and unless this shortens the complete title

RUNNING HEAD

The running head is set at the top of each right hand page of the printed article. It is usually a shortened title (at most about 40 characters and spaces) and need be only a key phrase identified with the main title The running head for a paper entitled Detection and nature of dominant lethal genes in *Lilium* might be Lethal genes in *Lilium*

and techniques used RESULTS, for the observations and data (but not a discussion of the literature) DISCUSSION for connecting new findings with previous studies, and for interpretations LITERATURE CITED (only publications mentioned in the text) Subheadings of different ranks may be desirable in a long article but should be used sparingly

ILLUSTRATIONS AND LEGENDS

Many articles need illustrations. All illustrations should be functional none should repeat material presented in tables or text. Black-and-white drawings graphs, and the like are reproduced as zinc engravings and printed as line cuts. Photographs and tone drawings may be reproduced as copper engravings and printed as halftones. Illustrations are generally called "figures" the designation "plates" is falling into disuse. Illustrations are expensive be certain yours are essential. Consult the editor before submitting color illustrations.

Strive for technical perfection in the original art work. Faults in the original are often accentuated in processing. Rectangular illustrations should be geometrically true drawings should be arranged to utilize a block of space economically Plan the whole layout carefully in keeping with the format of the journal in which you wish to publish. For the reader's convenience, arrange all lettering to be read from one position. For many helpful suggestions see the American Standards Association *Illustrations for Publication and Projection* (Bulletin Y15.1 1959)

Art work submitted with the manuscript should be 8½ × 11 inches or smaller Many illustrations benefit from some degree of reduction. Plan for about a 50% reduction of each line drawing and graph to minimize flaws and to produce better contrast. Remember that not only the over-all dimensions but also the thickness of individual lines, spaces, and letters will be reduced proportionally A reducing lens is helpful for inspecting a figure during preparation. Fig. 1 shows the effect of reduction on various patterns and letters. Indicate a linear scale on the figure itself, or state the magnification in the legend. Add a micron scale directly on the micrographs. The author has the responsibility to see that the magnification reported corresponds with the final reproduction. On maps include a scale of distance and a directional indication or marginal indications of latitude and longitude

When scaling illustrations for reproduction to proper size you can use the simple equation

$$\frac{\text{Reduced width}}{\text{Original width}} \times \text{original height} = \text{reduced height}$$

Content

Do not repeat the title Indicate the objective and topics covered State the methods. For new methods, give the basic principle, range of operation and degree of accuracy Omit references to literature illustrations, and tables. Call attention to names of new compounds, minerals, species, etc. to new numerical data such as physical constants and statistical results and to new items and observations, even though some may be incidental. Keep the abstract to 200 words or 3% (or less, if the primary journal so specifies), exclusive of literature citation.

Preparation of abstract

1) If the journal to which you are submitting the manuscript publishes simultaneous abstracts incorporate the abstract with the heading ABSTRACT in the article preceding the introductory statements, this will be edited (if necessary) and published with the paper A copy of the journal will be sent to *Biological Abstracts* for reprinting the abstract.
2) If the journal does not publish simultaneous abstracts, type an abstract separately headed by the name(s) of the author(s) and the address (in parentheses) followed by the title of the article journal name (leave space for volume pages and year) and text

   SMITH A. B (Univ Hawaii Honolulu) and KARAKAWA W Metabolism of phosphorus in sugar cane Am J Botany —(Text of Abstract)

Journal editors will complete the citation by inserting volume issue page numbers, and the year The editor will send this copy to *Biological Abstracts*.

Index Words

Place at the bottom of the separate copy of the abstract the words you consider proper to index it Usually five to eight suffice Thus the authors and editors may assist the abstracting journals to index the abstracts better and to publish the indexes sooner

HEADINGS

Headings point up the organization of the article for the reader and help the author when he uses them as an outline for writing. After the ABSTRACT and introductory statements, the main divisions of the article need principal headings MATERIALS AND METHODS for the general items

The geometrical method, illustrated in Fig. 2, is as follows. On a piece of paper the size (*ABCD*) of the original copy draw a diagonal line *AC*. Measure along the top the desired width (*AE*) of the cut and draw a perpendicular line (*EF*). The line *EF* gives the length of the reduced cut. This method can be used to determine the reduction necessary to fit an illustration into a given space.

Submit the original line drawings or equally good glossy prints with extra copies for the reviewers. Make black-and-white drawings with India ink on pure white stock or tracing paper; fuzzy lines and shades of gray will not reproduce clearly. Transparent overlays with patterns of lines, dots, stippling, or cross-hatching are available commercially; these are superior to hand-drawn patterns. Be sure the pattern does not obscure printing or other critical material underneath, and that the overlay is attached securely everywhere with no air bubbles beneath. Draw graphs on coordinate paper with consistent lines printed in pale blue, which does not reproduce; orange, yellow, green, and red grids reproduce as black. Never submit a map or illustration that has to be sent in a

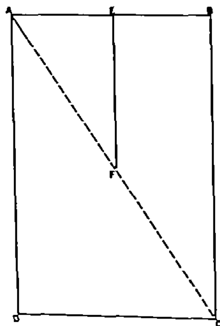
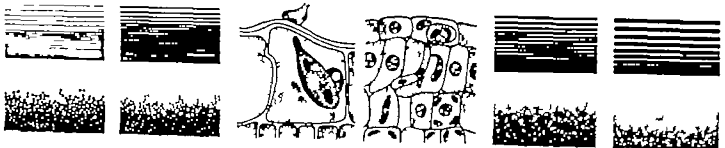


FIG. 2. A method for scaling illustrations.





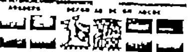


FIG 1 *Letters lines and dots in relation to reduction for the printed page Top—original size Lower left—½ size Lower right—¼ size Thin black lines hold up well but small black dots and white spaces between black lines or dots may be lost. Delicate shading may be obtained if it is kept rather open and if the size and spacing of the dots are adjusted to the amount of reduction from the original. Reprinted by permission of Riker and Riker*

The geometrical method illustrated in Fig. 2 is as follows. On a piece of paper the size (*ABCD*) of the original copy draw a diagonal line *AC*. Measure along the top the desired width (*AE*) of the cut and draw a perpendicular line (*EF*). The line *EF* gives the length of the reduced cut. This method can be used to determine the reduction necessary to fit an illustration into a given space.

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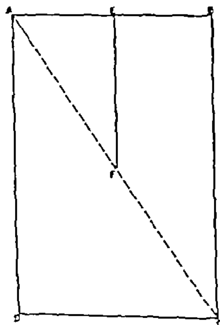
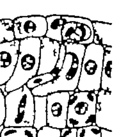
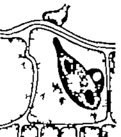


Fig. 2. A method of [illegible] [illegible] cut



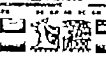










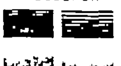




FIG 1 *Letters lines and dots in relation to reduction for the printed page. Top—original size Lower left —½ size Lower right—¼ size Thin black lines hold up well but small black dots and white spaces between black lines or dots may be lost. Delicate shading may be obtained if it is kept rather open and if the size and spacing of the dots are adjusted to the amount of reduction from the original. Reprinted by permission of Riker and Rike*

The parts of a table are (1) the *number* and *title* on the same line (2) the *boxhead* identifying the entries in the vertical columns (3) the *stub* identifying the entries in the horizontal lines (4) the *field* containing the data. Tables commonly have cross rules (1) a single rule below the title (2) a single rule below the boxhead (3) a single rule at the bottom of the table (Table 4) Additional rules (vertical or horizontal) may be needed if several subheads are used in the boxhead (Table 5) Because hand-set rules increase cost, many journals use no vertical rules (Table 6) and a minimum of horizontal rules a few use none.

Symbols and common abbreviations may be used in large tables to aid in setting the table. Do not use a minus sign or dash for entries in

TABLE 4 *Title* (Underline for italics)

	Boxhead
Stub	Field

TABLE 5. *Temperature characteristics of various homeothermic animals*[a]

Animal	Rectal temperature, C			Critical air temperature, C		Temperature-regulating mechanisms			Thermoneutrality zone, C
	Normal	Min	Max	Low	High	Sweating	Shivering	Panting	
Man	37	22	44	17–22	32 32	+[d]	+	0	23–31.8
Cat	37.2–39	17	43		32.2	0	+	+	10–30
Cow dairy	36–39		42.8	−40	21 27	0		+	4.4–15.6
Dog	39	17	42.8	−40	29	0	+	+	−40 to 30
Elephant	35.9–36.7					0	+		
Guinea pig	38.5–39.9	21		−15	29.5			+	30–31
Chicken	40–42	25–27	43	−34	32.2	0	+	+	16–35

[a] Adapted from original table. Spector W S. (Editor) 1956. *In* Handbook of biological data. W B. Saunders Co. Philadelphia.

Air temperature at which the first indication of change in rectal temperature occurs in the animal.

Range of air temperature over which the metabolic rate is lowest and constant in the animal.

Symbols + = mechanism present; 0 = mechanism absent.

mailing tube or separate package, have it reduced by photography and send a print with the manuscript.

Photographs for publication need high contrast and must be printed on glossy paper A size of about 5 × 7 inches is usually adequate. Many photographs can be improved by cropping off distracting or nonessential features. Mark each photograph *lightly* in soft pencil on the margin (front or back) with figure number author's name, and present magnification Indicate which side is the top Take care that no grooves, gouges, or creases appear on the face never use paper clips on glossy prints or write too firmly on the back. Several photographs can frequently be combined into a single illustration with one legend explaining the figures each designated by a letter or number Some journals require unmounted originals, but if mounted white paper should be used and the photos properly trimmed and neatly aligned Ship photographs flat (never rolled or folded) and protected by stout cardboard and a durable envelope commercial mailers are available

All illustrations must be referred to in the text as fig. x, and be numbered in one consecutive series. A circled note in the margin, as here shown enables the printer to place the figure correctly in the text.

Group the titles and legends, typed double-spaced and separate from the text, and do not attach them to the art work. Legends should be concise and yet clearly explain the figure Symbols with explanation should be on the figure if space permits. When symbols must be explained in the legend use only the following standard characters for which printers have type ○ ● ◒ ◑ □ ■ △ ▲ ×

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TABLES

Tables provide the most effective means for organizing extensive numerical data. They should make classification evident facilitate comparisons, reveal relationships, and save space A table should be self-explanatory The data may be referred to and discussed, but never repeated extensively in the text. Organize the data to bring out pertinent comparisons clearly Use no more digits than the accuracy of the methods justifies. Do not include columns of data that can be calculated easily from other columns. Use the metric system for measures and weights (see p 20)

Plan tables to use space efficiently and to fit either single- or multiple column formats. Large tables are costly and few journals will accept those requiring fold-out pages. Tables are usually typed parallel to the print line but extensive data may be set perpendicular.

The typed manuscript of tables should be *double-spaced throughout* including title, headings, and footnotes. Put each table on a separate sheet, cite in text as Table X, and indicate its approximate location in the text by a circled marginal note. Consult recent issues of the journal to which you intend to submit your manuscript and plan your tables accordingly.

MATHEMATICAL FORMULAS AND EQUATIONS

Numbers, letters, and symbols in formulas and equations must be clear and accurate, and they must be in proper alignment. Allow extra space—triple or even quadruple—around typewritten equations. If your typewriter does not have special symbols, draw them neatly by hand. Note in pencil obscure modifications of symbols such as prime marks, dots over symbols, etc. Carefully distinguish the letter "O" and zero, the letter "l" and the number 1, the degree symbol and superior letter "o" and zero. When "X" represents the multiplication sign, indicate lightly in pencil "mult. sign." Draw Greek letters carefully, inserting marginal notation such as "Gk. beta" to avoid error. Indicate type face by underlining as follows:

Roman capital letter triple underline

Roman small capital double underline

Boldface capital or lower case wavy underline

Italic capital or lower case single underline

Draw or type superior and inferior numbers, letters, and symbols (exponents or superscripts and subscripts) in the proper position. If there is any doubt about the proper position, pencil a caret $\wedge$ over the characters to be set inferior and an inverted caret $\vee$ under the characters to be set superior. Use combinations of $\vee$ and $\wedge$ as necessary to mark inferiors to superiors ([illegible]), inferiors to inferiors ([illegible]), superiors to inferiors ([illegible]), and superiors to superiors ([illegible]).

TABLE 6 *Occurrence of grasses of the tribe Hordeae in certain counties of Arizona*

County	Number of species of the genus		
	Hordeum	*Elymus*†	*Lolium*
Apache	2	7	0
Graham	1	7	1
Cochise	3	8	2

Compiled from Gould, Frank W 1951 Grasses of the Southwestern United States Univ Ariz Bull 22 1–343

† Includes the species that often are segregated in the genus *Agropyron*.

the field of a table when observations or tests are lacking Avoid odd alignments in columns whenever possible

Set.	aedf	ghkt	axy	*h ot*		ghkt	axy
		pdq	zdb		*aedf*	pdq	zdb
		sos	123			sos	123
			xyz				xyz

Footnotes to tables are frequently necessary They should immediately follow the table with each treated as a paragraph and referred to with a superscript letter (or symbol * † ‡ §)

Numerical data of equal length should be centered in the column If entries are unequal, center the longest and align the rest on the decimal, or at the right or the left margin Align data with standard deviations first on the ± then on the decimal points to the left and right

60	60 5	54 321	37	22 3 ± 1 5
40	125 3	4 321	37 2 39	647 ±51
8	49 9	321	33 –39	8 32± 0 12
57	0 5	21	35 9–36 7	0 64± 0 01

Examine data carefully to determine the significant digits percentages should be given to one decimal (20.2 %) unless extreme accuracy is both essential and possible

Use special type styles, such as boldface and italic, only if essential in boxhead stub and field for example italics for names of genera and species.

Plan tables to use space efficiently and to fit either single- or multiple-column formats. Large tables are costly and few journals will accept those requiring fold-out pages. Tables are usually typed parallel to the print line but extensive data may be set perpendicular.

The typed manuscript of tables should be *double-spaced throughout* including title, headings, and footnotes. Put each table on a separate sheet, cite in text as Table X, and indicate its approximate location in the text by a circled marginal note. Consult recent issues of the journal to which you intend to submit your manuscript and plan your tables accordingly.

MATHEMATICAL FORMULAS AND EQUATIONS

Numbers, letters, and symbols in formulas and equations must be clear and accurate, and they must be in proper alignment. Allow extra space—triple or even quadruple—around typewritten equations. If your typewriter does not have special symbols, draw them neatly by hand. Note in pencil obscure modifications of symbols such as prime marks, dots over symbols, etc. Carefully distinguish the letter "O" and zero, the letter "l" and the number 1, the degree symbol and superior letter "o" and zero. When "X" represents the multiplication sign, indicate lightly in pencil "mult. sign." Draw Greek letters carefully, inserting marginal notation such as "Gk. beta" to avoid error. Indicate type face by underlining as follows:

Roman capital letter   triple underline

Roman small capital   double underline

Boldface capital or lower case   wavy underline

Italic capital or lower case   single underline

Draw or type superior and inferior numbers, letters, and symbols (exponents or superscripts and subscripts) in the proper position. If there is any doubt about the proper position, pencil a caret ∧ over the characters to be set inferior and an inverted caret ∨ under the characters to be set superior. Use combinations of ∨ and ∧ as necessary to mark inferiors to superiors ([illegible]) inferiors to inferiors ([illegible]) superiors to inferiors ([illegible]) and superiors to superiors ([illegible])

Equations are extremely expensive to set in type for much handwork may be required particularly when built-up fractions, complicated exponents, radical signs and other forms which must occupy more than one line of type are involved Hence you should present your equations in the simplest clear form Simple forms can be obtained by ordinary mathematical manipulation factoring removing common factors clearing fractions, etc In addition, the following notations are helpful because the material can be set in one line on a machine

1) Use a case fraction instead of a built up fraction

$$\tfrac{1}{2}\,(\underline{a} + \underline{b})\,, \text{ not } \frac{\underline{a} + \underline{b}}{2} \qquad (1)$$

2) Use a fractional exponent instead of a radical sign

$$\underline{a}(\underline{bc})^{1/2}\,, \text{ not } \underline{a}\sqrt{\underline{bc}} \qquad (2)$$

3) Use the slant line (/) to avoid built up fractions, taking care to insert the necessary parentheses

$$\underline{x} = (\underline{a} + \underline{b})/(\underline{c} + \underline{d})\,, \text{ not } \underline{x} = \frac{\underline{a} + \underline{b}}{\underline{c} + \underline{d}} \qquad (3)$$

4) Use negative exponents when simplicity results

$$\alpha = \tfrac{2}{3}\,\underline{R}^{-1}\,\underline{g}\,\sin B\,, \text{ not } \alpha = \frac{2\,\underline{g}\,\sin B}{3\underline{R}} \qquad (4)$$

5) Avoid using a bar to mean average when more than one character is involved, instead, use pointed brackets with a subscript *avg*

$$\langle \underline{a} + \underline{b} \rangle_{\underline{avg}}\,, \text{ not } \overline{\underline{a} + \underline{b}} \qquad (5)$$

6) When the argument of an exponential function is complicated, use the form exp ' and type the argument on the line instead of superior

$$\exp \tfrac{1}{2}\,(\underline{V}_0/\mu\underline{D})\,(1 - \underline{Br}/\underline{A}) \quad \text{not } \underline{e}^{\frac{1}{2}(\underline{V}/\mu D)(1-\underline{Br}/\underline{A})} \qquad (6)$$

7) Avoid aligning superiors directly over inferiors. The expression $\underline{x}_{\underline{A}}{}^{2}$ is fully as clear as $x_{\underline{A}}^{2}$ and it can be set by machine (7)

Draw complex equations in India ink on a separate page

When several equations are used, number them in parentheses at the right to permit reference to them in the text.

STATISTICS

Statistics may be used in designing an experiment or a series of observations and in analyzing and interpreting quantitative data from a completed investigation. But statistical methods are based on probability; hence they neither support poorly designed and inadequately controlled experiments, nor prove the results beyond doubt.

In designing an experiment, keep in mind normal variations in biological materials, reliability of analytical methods, and errors arising from sampling. One can calculate how to extract the most information when time or material is limited, or if no limiting factors are known, with the least experimentation. But statistics cannot substitute for thought and common sense.

When analyzing data, emphasize the biological results, not the statistical methods. A simple statement that the analyses yielded certain results usually justifies the interpretations and conclusions. Do not include unnecessary mathematical details. Do not report separate results from a large number of uniform or corresponding experiments, especially when analyzing the characteristics of a population. Adequate information is usually supplied by (i) the number (N) of individual observations, (ii) the *arithmetic mean value* ($\bar{x}$), (iii) the *standard deviation* (SD, s, or s_x) or *standard error* (SE). Such information may be included in text or table as 32.1 ± 2.8 (7), where the numbers represent the mean ± SE or SD (indicate which) with the number of observations in parentheses. When reporting a difference between the means (or other statistics) of two groups of results, apply a test of significance or give the confidence limits. When representing statistical quantities by symbols, use Greek letters (σ, μ, etc.) for hypothetical characteristics of the population and roman letters (S, s, m, etc.) for actual measurements based on samples from the population.

Omit long descriptions of statistical methods except in manuscripts dealing specifically with statistics, but cite the source of any unusual methods.

CHEMICAL FORMULAS AND EQUATIONS

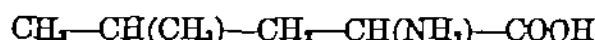
Chemical symbols and simple formulas may be used in text, tables, or figures as shorthand designations (Mg, Mn, HCl, CO_2, H_2SO_4, H_3PO_4, etc.). Ions may be indicated by adding symbols for the electrical charge (Mg^{2+} or Mg^{II}, SO_4^{--} or SO_4^{2-} or $SO_4^{=}$, H^+, Fe^{3+} or Fe^{III}, Cl^- or Cl, Na^+, etc.). The diatomic molecules of gases may also be denoted by their formulas (H_2, O_2, N_2, etc.).

When merely naming a salt, use its simplest formula (Na_2SO_4, KCl,

$FeCl_3$, etc.) but when mentioning quantities of normally hydrated salts, indicate the full molecular formula [$BaCl_2\ 2H_2O$ $Na_2SO_4\ 10H_2O$ $K_4Fe(CN)_6\ 3H_2O$] Avoid using a chemical symbol that can be mistaken for a word, particularly in beginning a sentence (*As* in these samples *He* was present in)

The formulas of simple organic substances may be used in the text if they save space and if they can be printed in a single line (*HCHO* CH_3COOH C_6H_5OH) Avoid ambiguous formulas (C_2H_6O may be alcohol or acetone $C_4H_6O_2$ could be any of at least eight substances) and also formulas of substances with closed ring structures they are difficult to print

Where structures of organic substances are important type or draw them carefully centered between lines of text, showing every significant detail clearly Show only the more important chemical bonds for example leucine may be written



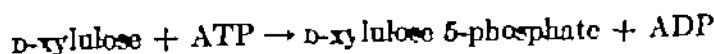
$$CH_3{-}CH(CH_3){-}CH_2{-}CH(NH_2){-}COOH$$

If all the bonds were indicated the formula would occupy far more space and would be more difficult to comprehend at a glance Avoid diagonal bond lines and diagonal arrows if possible

Complex formulas must often be set by hand and may turn out too large Accordingly provide well-designed India ink drawings of complex structures for reproduction by photoengraving Indicate the exact position in the text by a pencil drawing of the same structure

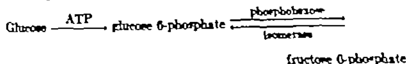
Isotopically labeled elements are indicated in American journals by the atomic weight of the isotope placed as a superior figure to the right of the symbol ($CH_3C^{14}OOH$ for acetic acid 1 C^{14} $C^{14}H_3COOH$ for acetic acid-2 C^{14}) British journals place the atomic weight to the left. When the name rather than the formula is used place the symbol of the isotope after the name (leucine-N^{15} thymidine H^3) If the position of the labeled element is known, show this by a number before the symbol (*sodium propionate-2-*C^{14}) if unknown or if the labeling is general omit the number (glucose C^{14})

Center chemical equations between lines of text. If they represent an equilibrium, use *the double arrow if the reaction goes to completion* a single arrow In presenting many biochemical reactions, the names rather than the formulas of complex organic substances are frequently used Abbreviations may be used if generally understood *For example* a reaction catalyzed by an enzyme found in mammalian liver may be written



D-xylulose + ATP → D-xylulose 5-phosphate + ADP

In general, chemical equations like mathematical equations should balance. Where it is necessary only to indicate the general course of a reaction influenced by a catalyst or specific reagent diagrams like the following are appropriate



DESCRIPTIONS OF SOLUTIONS

Express the concentration of solutions in chemical terms that is either in normality (N) or molarity (M) and attach a number (1.0 N hydrochloric acid, not N hydrochloric acid)

Use the decimal system for fractional concentrations (0.1 N hydrochloric acid not N/10 hydrochloric acid) Use only sufficient decimal places to indicate the accuracy with which the solution was prepared or standardized (0.502 N hydrochloric acid) For extremely dilute solutions use the form 1.0×10^{-4} M, or 1.0×10^{-4} N as the case may be The chemical definition of concentration is preferred because expression as percentage is frequently ambiguous 10% H_2SO_4 may mean 10 g of sulfuric acid (H_2SO_4 substance) in 100 ml of solution, or 10 ml of concentrated sulfuric acid (the commercial reagent which may be from 95 to 98% by weight or approximately 36 N) in 100 ml of solution 10% sodium sulfate may be 0.07 M, 0.037 M, or 0.03 M, according to whether the anhydrous salt, the heptahydrate or the decahydrate was weighed

If you do use a percentage specify the exact chemical substance weighed or measured, and whether by weight and volume (w/v) or by volume only (v/v) Dilutions of ethyl alcohol, for instance are usually made from commercial alcohol of density 0.810 which has a concentration of 92.3% by weight and 94.9% by volume

Sometimes special methods are used to prepare and describe solutions A 1.0 molal solution contains 1.0 mole of the substance dissolved in 1,000 g of solvent. A 1.0 weight molar solution contains 1.0 mole of substance dissolved in sufficient water so that the solution weighs 1,000 g. Weight molar solutions are measured by weight.

CHEMICAL ANALYSES AND PHYSICAL PROPERTIES OF COMPOUNDS

Give reference to all analytical or procedural methods not widely known. If you use an important modification of a fundamental method, state this (e.g., nitrogen was determined by the Kjeldahl method as

modified by Hiller et al., 1948) Where the modification is trivial, cite only the fundamental publication. If your method is original, at least in part, describe it briefly, avoiding inconsequential details. The reader needs to know that a precipitate was centrifuged in the cold at 2,000 × *g* but the make and type of centrifuge is usually unimportant. Since analytical chemists invariably use distilled or deionized water, this need not be mentioned unless specially purified water is essential. "The crystals were collected by filtration on a Büchner funnel transferred to a weighing bottle, dried in a vacuum desiccator over phosphorus pentoxide and weighed on an analytical balance" simply means that the crystals were filtered, dried in vacuo, and weighed the rest is padding The technical competence of the reader must be assumed.

Report analytical results in the following conventional form

Analysis $C_{17}H_{18}N_4O_4$ calculated C *59.29* H *5.85* N *16.27*
Found C 58.8 H 6.03 N 16.2

Note the punctuation the omission of the percentage symbol and that the calculated values are given to four significant figures. The analytical results are given to only three figures, the last being adjusted Only when extreme precautions are taken is a fourth figure justified

Report the data on physical properties in the text in the following standard form, indicating special conditions of measurement

Specific rotation $[\alpha]_D^{22} = -20 \pm 2°$ (1 0 M in water)

Melting point 140–142 C (unc) or (cor) (copper block) (sealed tube)

Boiling point bp 120 C at 15 mm

Specific refractive index $[n]_D^{18} = 1.4767$

Record temperature wavelength of the light used in measuring specific rotation the solvent, and concentration of the solute.

Statements of melting points should indicate whether you applied a correction for stem emergence of the thermometer If no statement is made about technique it is understood the substance was heated in an open tube immersed in a suitable bath. Avoid the somewhat ambiguous term "mixed melting point by writing "mp 178–179 C (unc) and the mixture with an authentic sample of mp *179–180* C (unc) *had* mp *177–179* C (unc)." Boiling points are recorded at atmospheric pressure unless otherwise stated

Chromatographic evidence *for identity and purity* is better presented by India ink tracing of the paper than by photographs. State the kind of paper the solvent the conditions and the R_f values of all components present, *together* with those of authentic materials. Note that R_f means the ratio of the movement of the substance to that of the front, and that

R is an italic capital and the F an inferior italic small capital (not lower case); also that the process is chromatography; the paper is a chromatogram. Avoid such neologisms as *papergram*. One does not "elute (or extract) the spots," nor does one "extract the paper"; one elutes or extracts the substance from the paper. In column chromatography one does not "pool the tubes," or "titrate the tubes"; least of all does one "mix the tubes"; but the *fractions* or *contents* of the tubes.

METABOLIC QUOTIENTS

Suggestions for expressing metabolic quotients are:

1) a) The symbol Q_x may represent metabolic quotients *only* in the units of μl of gas X/mg dry wt of biological material/hr.
   b) If the metabolite X is a solid or liquid, it is conventionally considered as a gas at normal temperature and pressure (NTP), 1 μmole of X being equivalent to 22.4 μl.
2) Metabolic quotients in other units, such as μmole of X/mg dry wt/hr, μl of X/mg N/sec, may be represented by the symbol q_x.
3) Define the units for Q or q clearly when first mentioned.
4) Indicate production and removal of metabolites by positive or negative quotients; omit the symbols (+ or −) if there is no confusion.
5) Indicate aerobic or anaerobic conditions thus:
   $Q^{O_2}_{CO_2}$, $Q^{N_2}_{CO_2}$, $q^{O_2}_{CO_2}$, $q^{N_2}_{CO_2}$
   Measurements in another gas may be indicated thus: $Q^{H_2}_{CO_2}$.
6) Indicate substrate in parentheses: Q_{CO_2} (pyruvate).
7) One may omit the symbols Q_x or q_x, if he states the units (μmoles/g wet wt/hr) whenever a quotient is mentioned.

CHEMICAL NOMENCLATURE

The index of *Chemical Abstracts* is the authority for the names of chemical compounds in the United States and Canada. Consult it in all doubtful cases. But many common names not derived under the rules of chemical nomenclature are current and useful: trivial and trade names (aspirin, cellophan, DDT, 2,4-D); coinages to suggest chemical structure (methonychlor). Many trade names are officially registered and, if used, must be spelled and capitalized according to the owner's usage (Vaseline, Adrenalin). Use caution and common sense following good usage in your field. A biochemist writing on mechanisms of respiration may properly use the name α-ketoglutaric acid, although *Chemical Abstracts* indexes this substance as 2-oxoglutaric acid. A plant patholo-

modified by Hiller et al., 1948) Where the modification is trivial, cite only the fundamental publication. If your method is original at least in part, describe it briefly avoiding inconsequential details. The reader needs to know that a precipitate was centrifuged in the cold at 2,000 × g but the make and type of centrifuge is usually unimportant. Since analytical chemists invariably use distilled or deionized water this need not be mentioned unless specially purified water is essential. "The crystals were collected by filtration on a Büchner funnel, transferred to a weighing bottle dried in a vacuum desiccator over phosphorus pentoxide and weighed on an analytical balance" simply means that the crystals were filtered dried in vacuo and weighed the rest is padding The technical competence of the reader must be assumed.

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a few other asymmetric substances These prefixes signify the configurational family they have nothing to do with the direction in which the substance rotates the plane of polarized light. L-Alanine is dextrorotatory when you must indicate direction of rotation write L(+)-alanine Prefix an italic *d* or *l* when the configurational relationship of the substance to D- or L-glyceraldehyde is unknown. These prefixes do denote the direction of rotation of the substance under a standard condition. But the small capital letter prefixes have been so misused and misunderstood that the (+) and (−) signs to denote the dextro- and levorotatory isomers of many substances may be necessary The name (+)-tartaric acid is clear and unequivocal D-tartaric acid is correct (as X-ray analysis of the crystal structure has shown) L-tartaric acid is incorrect although often used. This is one of the few substances for which current rules of nomenclature have proved inadequate

If you refer frequently to substances with complex and difficult names draw the structures labeling them with the proper name and a Roman numeral, and then refer in the text to substance (or acid ketone etc) III or V or IX, as the case may be

ANATOMICAL NOMENCLATURE

The international standard is *Nomina anatomica Parisiensis* (1955) *et B N A* (1895) edited by Woerdeman (1957) The 5,640 terms are in Latin, but the International Anatomical Nomenclature Committee "holds each country to be at liberty to translate the official Latin terms into its own vernacular for teaching purposes" The best source of translations of anatomical terms from Latin to English is the Birmingham Revision of the Basle *Nomina anatomica* (University Press Glasgow 1933)

In good English usage some terms (e.g., femur cisterna chyli) are seldom translated, others may or may not be (as tela subcutanea or subcutaneous tissue) but most are given in Anglicized form (e.g., stomach for ventriculus brachial plexus for plexus brachialis) Avoid antiquated names (as innominate bone for hip bone astragalus for talus) and obsolete usage (e.g., internal and external, if medial and lateral are intended)

NOMENCLATURE OF ORGANISMS

General Principles

Biological nomenclature is designed to achieve stability and universal acceptance of scientific names of organisms Authors and editors are

gist may mention nabam,' which is indexed by *Chemical Abstracts* under this name but with the instruction *see* disodium salt under Carbamic acid ethylenebis dithio-

Many abbreviations for long complex names of organic compounds are current TPN for triphosphopyridine nucleotide ATP for adenosine triphosphate Avoid coining your own abbreviations, rephrase to avoid *repetitions of cumbersome terms. But if you must use such abbreviations,* define them exactly at first use and *never* use them in titles or abstracts.

List drugs, insecticides and related preparations by their chemical names when possible otherwise by generic names. For generic names consult *The Pharmacopeia for the United States of America* (USP), the *National Formulary* (NF) *New and Nonofficial Drugs* (NND) or lists of common names accepted by national scientific societies (e.g names of insecticides approved by the Entomological Society of America) For substances not listed in these compendia use a trade name followed the first time by its chemical or scientific name in parentheses. Capitalize all trade names but omit the registry symbol®

The chemical formulas of common and simple substances (H_2O CO_2, HCl NaCl etc.) may be used in the text or in table headings especially if such terms occur repeatedly even though such formulas imply definite quantities. To write 5 ml of H_2O is illogical because the formula H_2O strictly speaking means 18 g (or parts by weight) of water But here custom overrules logic

Complex names, especially of organic substances, should be given their full scientific name at least the first time they are used. Subsequently the common name will serve but use good judgment 'phthalic acid serves better than 1 2 benzenecarboxylic acid and phenol than carbolic acid Avoid antiquated names muriatic acid (for hydrochloric acid) copperas (for ferrous sulfate) blue vitriol (for copper sulfate) or potash, soda, baryta Glauber's salt, Rochelle salt, etc

References to quantities of inorganic salts or hydrated organic substances *should specify the number of molecules of water of hydration* in the quantity of the substance thus copper sulfate pentahydrate sodium sulfate decahydrate, asparagine monohydrate histidine monohydrochloride monohydrate etc

Many names of organic substances include numbers letters or syllables designating details of the chemical structure Transcribe these accurately There are several isomers of dinitrophenol for instance, and the exact one used must be made clear Check for errors in the use of the small capital D and L in names of sugars and amino acids and of

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Infraspecific Categories

The three codes of nomenclature differ regarding subdivisions of species. The *Botanical code* recognizes taxa subordinate to species such as subspecies variety subvariety forma and subforma (*Andropogon ternatus* subsp. *macrothrix* *Saxifraga aizoon* var *aizoon* subvar *brevifolia* forma *multicaulis* subforma *surculosa*) The *Bacteriological code* recognizes no infraspecific taxon subordinate to the rank of subspecies and considers variety synonymous with subspecies. This *Code* recognizes such infrasubspecific taxa as strain serotype group, phase forma specialis, variant, stage, and state. The *Zoological code* recognizes subspecies and will accept names for variety and forma up to 1961 but will not govern names in infrasubspecific categories. The botanical term "variety" (abbreviated var or v) is restricted to variant forms of wild plants that have been given Latin names as true botanical varieties, even though they may have been brought into cultivation (*Viola tricolor* var *hirta*)

Horticultural Varieties

Names of cultivated varieties of plants (cultivars) are printed in roman type set off with single quotes after the Latin names of the species (*Saintpaulia ionantha* 'Calico *Lycopersicum esculentum* Red Cherry') Many cultivars have Latin names which must be retained. Consult the *International Code of Nomenclature of Cultivated Plants* (Vilmorin et al 1958)

Citation of Author

The person first publishing a scientific name for any taxon, under conditions prescribed by the codes is its author In taxonomic papers the name of a taxon should be supplemented with the name of *its* author (*Homo* Linnaeus *Musca domestica* Linnaeus *Magnolia grandiflora* Linnaeus *Virales* Breed Murray and Hitchens 1944 *Clostridium pasteurianum* Winogradsky) The author citation need appear only once in the article but usually not in titles

When a species or subspecies is transferred to a genus other than that in which it was first placed, the name of the original author of the species is placed in parentheses The authority of the new combination follows, but is not placed in parentheses *Shigella dysenteriae* (Shiga) Castellani and (or et) Chalmers *Spiraea latifolia* (Ait.) Borkh. The *Zoological code* does not recommend citing the authority of the new combination.

obligated to accept the rules governing nomenclature in the *International Code of Botanical Nomenclature* (Lanjouw et al. 1956), the *International Code of Nomenclature of Bacteria and Viruses* (Buchanan et al., 1958) and the *International Code of Zoological Nomenclature* (revised edition 1960, in press) The essential features of zoological nomenclature also appear in *Procedure in taxonomy* (Schenk and McMasters, 1956) and current lists of families, genera and species are available from the International Trust for Zoological Nomenclature. Because of usage and of inherent differences among animals plants, and microorganisms, the codes differ in certain basic principles.

Systematic Categories

The basic taxa (*singular* taxon), in descending order are phylum or division, class, order family genus, and species. The scientific name of species in all disciplines is a binary combination (botany, bacteriology) or binomen (zoology), and consists of the generic name followed by the specific epithet (botany and bacteriology) or specific name (zoology) The scientific names of all taxa are Latin or Latinized forms, and are to be so treated.

To be validly published and have standing in nomenclature, the name of a newly proposed taxon of recent plants (not fossil plants) except bacteria, must be accompanied by a Latin description or a reference to a previously and effectively published Latin description. Effective dates of this requirement are 1 January 1935 for plants other than algae and 1 January 1958 for algae. Authors should not submit (or editors accept) manuscripts that violate this rule. Latin diagnoses are not required by the *Zoological* and *Bacteriological codes*.

Capitalization

Do not use the specific name or epithet alone when referring to a species it must be preceded by the generic name (or abbreviation) The generic name, however or that of any higher rank, may stand by itself Capitalize names of genera and of all higher taxa. Generic names may be abbreviated to the capitalized initial letter when followed by a specific epithet (name) if the context makes the meaning clear Never capitalize specific names (epithets) or subspecies taxa (except where permitted by the *Botanical code*) Generic names used as vernacular names are neither italicized nor capitalized (*see* p 54) *Petunia*, petunia *Mastodon*, mastodon *Bacillus*, bacillus avena test.

lar verb. Custom also sanctions the vernacular usage of plural generic names. Examples: The salmonella is   but the salmonellae (brucellae, corynebacteria, clostridia, sarcinae) are   The Latin plural of a generic name is preferred in bacteriology but English plural endings are used exclusively in certain cases (pseudomonads for *Pseudomonas*) and others sometimes (e.g., *salmonellas, shigellas,* vibrios, sarcinas). Occasionally more than one vernacular form is derived from a generic name, as treponema or treponeme from *Treponema*, and streptomycete or streptomyces from *Streptomyces*.

KEYS FOR IDENTIFYING ORGANISMS

The ideal key to a group of organisms presents rigorously selected information so that a series of correct choices leads to the identification of an organism unknown to a user of the key. This results only if the key has been properly constructed, if the user interprets his material and the key correctly, and if the organism has been included. Lawrence (1951) and Metcalf (1954) have presented helpful ideas on the construction of keys. Keys constructed to show relationships or phylogeny tend to be less functional and to become only synopses of taxa. Thus in preparing and using keys it must be recognized that they provide, except perhaps in the most specialized works, only a useful and workable means of identifying organisms, and not always an accurate picture of phylogenetic lines or natural relationships.

Several different types of keys appear in botanical, zoological, and bacteriological publications. Some keys separate only two species, others separate hundreds of taxa. Guiding principles for construction of a key are (Metcalf, 1954):

1) Simplicity. Write entries in the keys as simple, direct, and mutually exclusive couplets; thus, a dichotomous key.
2) Clarity. State the first member of the couplet in the positive and the second member as a negative statement of the characters displayed in the first.
3) Reversibility. Construct the key so it can be used backward as well as forward. This is helpful, because if an erroneous choice is made at one couplet it is possible to retrace and find the point of divergence.

Examples of keys that illustrate these principles are

Typography

Biological publications generally italicize scientific names of genera subgenera, species, and subspecies. New names of taxa above genera may be italicized. The names of taxa proposed as new to science as new names or as new combinations, and appearing in print for the first time are commonly set in boldface type Generic names used as vernacular names are not italicized

Vernacular or Common Names

Many plants and animals are known by their vernacular (provincial common) names as well as their scientific names. Vernacular names for the same organism are usually different in each language Nomenclatural rules and custom in various disciplines govern the appropriateness and use of vernacular names

The Entomological Society of America approves the common names of approximately 1,500 insects. Examples alfalfa looper cat flea chigger silverfish *zebra caterpillar* When *proposing new common names for* insects (1) use one name for a species, and avoid names of more than three words (2) do not employ parts of a scientific name unless thoroughly established by usage (3) for insects of concern in both the larval and adult stages, use the name for the most important or best known stage

The American Ornithologists Union (1957) publishes a check list of scientific and vernacular names for species (but not subspecies) of North American birds. The names follow the Union *Code of Nomenclature* Initial capital letters are recommended for complete vernacular names of species but not for general vernacular names (subspecies) Examples Bald Eagle Baird s Sandpiper Great Auk, Ruby throated Hummingbird *but* eagle sandpiper auk and hummingbird

Common plant names are seldom capitalized But names derived from proper *nouns may retain the initial capital letter and be hyphen*ated or set as two words omit apostrophe in names with a possessive element. Examples Alpine-azalea Cupids-dart Dutchmans-pipe English ivy flower-of-Jove Grays lily Proper names, e.g *lose their capital in* fanciful names jack in the-pulpit blue-eyed mary and brown-eyed susan

An English name (vernacular) may be coined from any bacterial genus But a generic name is a noun in the singular and requires a singu

by verb. Custom also sanctions the vernacular usage of plural generic names. Examples: The salmonella is ... but the salmonellae (brucellae, corynebacteria, clostridia, sarcinae) are ... The Latin plural of a generic name is preferred in bacteriology but English plural endings are used exclusively in certain cases (pseudomonads for *Pseudomonas*) and others sometimes (e.g., salmonella, shigella, vibrios, sarcinas). Occasionally more than one vernacular form is derived from a generic name as treponema or treponeme from *Treponema*, and streptomycete or streptomyces from *Streptomyces*.

KEYS FOR IDENTIFYING ORGANISMS

The ideal key to a group of organisms presents rigorously selected information so that a series of correct choices leads to the identification of an organism unknown to a user of the key. This results only if the key has been properly constructed, if the user interprets his material and the key correctly, and if the organism has been included. Lawrence (1951) and Metcalf (1954) have presented helpful ideas on the construction of keys. Keys constructed to show relationships or phylogeny tend to be less functional and to become only synopses of taxa. Thus in preparing and using keys it must be recognized that they provide, except perhaps in the most specialized works, only a useful and workable means of identifying organisms and not always an accurate picture of phylogenetic lines or natural relationships.

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3. Reversibility. Construct the key so it can be used backward as well as forward. This is helpful, because if an erroneous choice is made at one couplet it is possible to retrace and find the point of divergence.

Examples of keys that illustrate these principles are

Key to the families of the order *Myriangeales* (After Wolf and Wolf 1947)

A Asci arising at different levels
  B Stroma massive, of homogeneous texture without a rind
    Family 1 *Myriangiaceae*
  BB Stroma effuse interior gelatinous, exterior crustose
    Family 2 *Elsinoeaceae*
AA. Asci arising at one level
  C Stroma naked   Family 3 *Saccardiaceae*
  CC Stroma with crustose rind
    D Multiloculate
      Family 4 *Dothioraceae*
    DD Uniloculate or perithecium like
      Family 5 *Pseudosphaeriaceae*

Key to the genera of the family *Heteromyidae* (After Cockrum, 1957)

1 Soles of hind feet densely haired interparietal less than one-fourth of greatest width of skull 2
1′ Sole of hind feet naked or haired only from heel to plantar surface interparietal more than one-fourth of greatest width of skull 3
2(1) Length of hind foot more than 23 mm tip of tail tufted occlusal surface of upper premolars elliptical *Dipodomys*
2 Length of hind foot less than 32 mm tip of tail not tufted occlusal surface of upper premolars rectangular *Microdipodops*
3(1′) Pelage silky or hispid never spiny upper incisors grooved bullae excessively inflated *Perognathus*
3 Pelage spiny upper incisors not grooved bullae not excessively inflated (not reaching level of grinding surfaces of molars) *Liomys*

DOCUMENTATION AND QUOTATION

Quotation and documentation by tables graphs, and pictures are often necessary for clarity and forcefulness Illustrations should be worth the space they will occupy and they should not duplicate text or tables. Limit quotations to essential passages Selected phrases are superior to long quotations which may require additional explanation. Unless the quotation is brief and pointed a paraphrase or résumé is preferable

Quotations should reproduce the original *exactly* in spelling capitalization italics, and punctuation You may correct obvious typographical errors, but other irregularities should be exactly reproduced immediately followed by [sic] which assures the reader that you are quoting

accurately If you italicize part of a quotation, say so in parentheses like this "omit *useless* words" (italics added) The parentheses are outside the quotation marks but inside the period.

Enclose in square brackets any words you interpolate within a quotation. "In this [precise] manner " Parentheses around your own remarks within another's statement falsely identify the words as his Add brackets by hand if your typewriter lacks them. Indicate an ellipsis within a quoted sentence by three *spaced* periods (see Period, p 11)

Type quotations of three lines or less as part of your text, between quotation marks. Type longer quotations double-spaced, with subparagraph indention and omit quotation marks. Do not further indent the first line of a quotation even if it begins a new paragraph, but preserve subsequent paragraphing.

Quotations of ten or more printed lines from recent works normally require permission from author or publisher Shorter quotations may require permission if they are summative and significant. The rules of publishing houses vary often requiring permission only for quotations of more than 250 or 300 words. The following "Reciprocal Agreement on Permission to Quote" was signed in 1947 by all members of the Association of American University Presses (this does not include commercial publishers)

1) Each party to this agreement agrees to permit the other parties to quote from the originating publisher's books *without seeking specific permission* subject to the conditions listed below

2 Full credit will be given to book, author and publisher (and series and translator if any)

3) Waiver of the requirement for specific written permission does not extend to verse to illustrations to quotations totaling more than 1,000 words from any one book, or to quotations that are complete units in themselves as brief short stories or essays)

4 It is clearly understood that this agreement applies only to quotations used for purposes of illustration or the citing of authority and not to quotations presented as primary material for its own sake (as in anthologies or books of readings) The responsibility of determining the nature of the use rests with the quoting publisher

When asking permission to quote identify the material by full, accurate references. The initial copyright period is 28 years in the United States, with a single renewal permitted.

FOOTNOTES

Use footnotes *only when absolutely necessary* for presenting explanatory material not appropriate to the text or tables. Examples are change of

author's address, and prescribed statements relating to dissertation institutional approval and contribution number if necessary Indicate a footnote in the text by a superior number ([1] [2] [3]) Place reference numbers after the word or statement annotated and number consecutively throughout, starting with those on the title page Type footnotes for the text double spaced on a separate page with each entry as a separate paragraph headed by its number corresponding to the reference in the text.

Footnotes to tables should be placed at the foot of the table and not on a separate page To identify each, use symbols or superscript letters (*see* p 42 and footnotes to Tables 5 and 6)

Never use a footnote in an abstract.

ACKNOWLEDGMENTS

A section headed acknowledgments may be placed between the text and *Literature Cited* Avoid acknowledgments as footnotes to the title or to words in the text Do not use a credit line (with the technical assistance of) *immediately after the name of the author(s) because your* assistant may be inadvertently cited as an author

When statements, tables, or figures are borrowed from published material written permission from the copyright owner must be obtained and acknowledged in the article. It is courteous to ask the author and *editor even if material is not copyrighted. Copyright owners sometimes* specify the phrasing for credit lines.

LITERATURE CITED

Basic considerations in making bibliographic references are accuracy readers' convenience and librarians time

In the text, citations should be made consistent (according to the practice of the journal) by use of one of the following systems

1) *Name-and year system* Depending upon the construction of *the sentence the citation will appear as* Smith and Jones (1960) (Smith and Jones 1960*a*, *b c*) With not more than three authors, name all in the first reference e g Doe Miller and Wilson (1960) but subsequently use Doe et al (1960) four or more authors should be cited Doe et al (1960) in the first instance
2) *Number system* Depending upon the construction of the sentence the citation will appear as Smith and Jones (1) or (Smith and Jones, 1) or merely (1) If citations are to be numbered number them after all additions and deletions have been made

List citations at the end of the paper in alphabetical order Include only those cited in the text. Do not cite unpublished work unless the paper has been accepted for publication. Citations should contain all the data necessary to locate the source easily in a library Check all parts of each citation against the original. An inaccurate or incomplete reference wastes time of readers and librarians.

Most journals have their own style for capitals italics boldface and so on, in literature citations. Consult a recent issue Literature citations must be typewritten and double-spaced.

The critical items for literature citations follow

1) *Authorship*. The family name of the first or sole author precedes the initials or given name Cite names of all co-authors as given in the by-line

It is usually not difficult to invert the family and given names of the first or sole author in preparing a reference list. Personal names in many countries usually correspond in form to *John C Smith*, and can be easily inverted (*Smith, John C*) But designations of rank within a family and compound and hyphenated family names of foreign origin may present problems.

Junior (Jr) and designations of rank within a family such as *II* and *III* are indicated after the initials (F W Day Jr., inverts to Day F W., Jr C. G. Child II to Child, C. G II.) The Spanish word *hijo* (h.) means *junior* and should be translated Gonzalo Ley (hijo) to Ley Gonzalo Jr Also maintain the paternal or maternal names in Spanish *Casimir Gomez Ortega* inverts to *Gomez Ortega C* not *Casimir O G*

Compound and hyphenated *American* family names, irrespective of origin, are treated in the same manner as other American names

Examples	*Invert to*
Henri Vander-Brink	Vander-Brink, H
A. B. van Niel	Van Niel, A. B.
R. P De Smet	De Smet R. P
S Bayne-Jones	Bayne-Jones S.
J de Bueno	De Bueno J
T l'Eltore	L'Eltore T

Compound family names in publications from other countries (Canada, Czechoslovakia, England, Finland, Germany Italy Poland, Scandinavia, Spain, and USSR, etc.) are similarly inverted and the particles capitalized.

For *Brazilian* and *Portuguese* names the particles (*do da, dos, das*)

author's address, and prescribed statements relating to dissertation institutional approval and contribution number if necessary Indicate a footnote in the text by a superior number ([1] [2] [3]) Place reference numbers after the word or statement annotated and number consecutively throughout, starting with those on the title page. Type footnotes for the text double-spaced on a separate page with each entry as a separate paragraph headed by its number corresponding to the reference in the text.

Footnotes to tables should be placed at the foot of the table and not on a separate page To identify each use symbols or superscript letters (*see* p 42, and footnotes to Tables 5 and 6)

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2) *Number system* Depending upon the construction of the sentence the citation will appear as Smith and Jones (1) or (Smith and Jones, 1) or merely (1) If citations are to be numbered number them after all additions and deletions have been made

The particles (von, vom, zu, zum, zur) and their abbreviations in German names follow initials when inverted, and should be spelled out

C. von Holt	Holt, C. von
H. zur Horst-Meyer	Horst-Meyer, H. zur
Ludwig v. Oberreit	Oberreit, Ludwig von

In Hungarian journals the family name regularly precedes the given name and inversion is unnecessary

Farkas Károly	Farkas, K.
Szent-Györgyi Albert	Szent-Györgyi, A.

If *Sen* or *Das* precede an *Indian* name, include it with the family name

B. C. Sen Gupta	Sen Gupta, B. C.
K. P. Das Gupta	Das Gupta, K. P.

All elements of *Thai* names are taken in the order in which they appear in the journal, joined by hyphens, and lower case is used for the second element

Nguyen Lam Tiep	Nguyen-lam-Tiep

2) The year of publication follows the authorship: Jones, T. C., and R. Doe. 1959

When more than one paper by the same author(s) has appeared in a given year, the letters *a*, *b*, etc., should be used after the year (e.g., Smith, 1959*a*, *b*). In the references each entry should be typed separately, with the same letters after the date as appear in the text (e.g., Smith, R. P. 1959*a*, Smith, R. P. 1959*b*).

3) The *title* appears exactly as on the first page of the article and on the title page.

4) Abbreviations are commonly used for the names of serial publications, except for one-word titles. Follow the abbreviations listed by The Chemical Abstracts Service (1956–1960) (see examples p. 68). If no abbreviation is found, use the following rules from the *International Code for the Abbreviation of Titles of Periodicals* (ISO/R4-1953):

a) Do not abbreviate so much it is impossible to identify the title and the language. Never change the word order.

b) Do not abbreviate a one-word title.

c) Never abbreviate personal names when they begin a title.

d) Omit articles, conjunctions, prepositions, and unimportant

follow the initials

Silvio do Amaral	Amaral Silvio do
A. C. dos Santos	Santos A. C dos

In *Chinese* publications the family name precedes the given name (usually hyphenated)

Chen Tai-chien	Chen Tai Chien
Lin Ke-sheng	*Lin Ke-Sheng*

But in American and British journals *Chinese* names are usually Anglicized and inverted

C. Ying Chang	Chang, C. Y
Hsi Fan Fu	Fu H. F

With *Dutch* names, particles and particle phrases follow initials when inverted

L. A. de Vries	Vries, L. A. de
Willem van Eyck	Eyck Willem van
J van der Hoeve	Hoeve J van der
L. W van Horts van Bing	Horts van Bing L. W van

Egyptian and other Arabic proper family names appear last

Hassan Fahmy Khalil	Khalil H F
Mohamed Metwali Naguib	Naguib M. M

When either prefixes and their variants (*el ibn abdel abd-el, abdoul, abu abou, aboul*) or the particle *el* alone precede names, they should be hyphenated to the name they precede

Aly Abdel Aziz	Abdel Aziz A
Youssef Abou-el Ezz	Abou-el Ezz Y
Aziz Ibn Saud	*Ibn-Saud A*
Kamel el Metwali	el Metwali K
Hedieh Khalil el Agouz	el Agouz *H* K

In compound *French* names the definite article (*le la, les*) or combinations with the preposition *de* (*du de la des*) precede the family name *De* (or *d'*) alone follows the initials

J Le Beau	Le Beau J
R. L'Epée	L'Epée, R.
V du Bary	Du Bary V
A. de Bary	Bary A. de
B d Aubiac	Aubiac B d

Author: Prefix in name not Anglicized or French article. Pages separated

Bary, A. de. 1886. Ueber einige Sclerotinien und Sclerotienkrankheiten. Botan. Ztg. 44: 377–387, 393–404, 409–426, 433–441, 449–461, 465–474.

Author: Hyphenated name (Compound name without hyphen) Subtitle

Gwynne-Vaughan, Helen. 1922. Fungi: Ascomycetes, Ustilaginales, Uredinales. Cambridge Univ. Press, London. 232 p.

Author: Transliterated names; Volume omitted; Each issue numbered independently:

Gavrilov, K. A., and T. S. Perel. 1958. Earth worms and other invertebrates in the soil under forests in Vologda region. [In Russian] Pochvovedenie 1958(8): 133–140.

Author: Transliterated name; English title on original; Annals of Society; Number paged separately; Summary in English:

Nishikado, Y. 1921. On a disease of the grape cluster caused by *Physalospora baccae* Cavara. [In Japanese; English summary] Phytopathol. Soc. Japan, Ann. 1(4): 20–42.

Author: Committee chairman; Preposition omitted from name of publication:

Riker, A. J., chmn. 1952. Literature citations: how biologists like them. Am. Inst. Biol. Sci. Bull. 2(1): 18–19.

Author: Society committee; Serial name of one word not abbreviated

American Phytopathological Society, Committee on Standardization of Fungicidal Tests. 1943. Definitions of fungicide terms. Phytopathology 33: 624–626.

Author: Service agency omitted as publisher

Chemical Abstracts Service. 1956. List of periodicals abstracted by Chemical Abstracts with key to library files and other information. Ohio State Univ., Columbus 10, Ohio. 314 p.

Author: State institution; Fiscal year; Special part; Bulletin:

Wisconsin Agricultural Experiment Station. 1950. What's new in farm science: sixty-sixth annual report 1948/49. Part I. Wisconsin Univ. Agr. Expt. Sta. Bull. 491, 83 p.

Author: Federal agency; Two or more volumes:

U. S. Bureau of the Census. 1927. United States census of agriculture 1925. U. S. Govt. Printing Office, Washington. 3 v.

Author: Federal agency; Pages not numbered:

U. S. Department of Agriculture, Plant Pest Control Division, Pesti-

words (in long titles), except where they form a part of a title consisting of only two other words, neither being a generic name

e) Form abbreviations by omitting the last letters (at least two) of the word terminate abbreviation after a consonant or group of consonants.
Replace letters by a period (full stop) Example Pétrogr (*not Pétrog*) *for Pétrographie*

f) Indicate plurals only when necessary

5) *Volume and pages of serials* appear in Arabic numbers after the abbreviated name of the periodical 2 120–136 An issue, number, supplement or other part within a volume is shown in parentheses only when paged independently 2(4) 1–56 34 (Suppl 2) 1–28 *Any special series* (Ser 3 *III or C*) *precedes the volume* number Ser 3 2 120–136 III 2(4) 1–56 C 2 120–136

6) In *book citations* the following appear in sequence after the title the edition if other than the first, the publisher's name or shortened name (according to the *Cumulative Book Index*) the place of publication, and the number of pages if one volume, but the number of volumes if more

7) *Illustrations* are not mentioned unless *separately paged* from the text or of particular importance

8) *Transliteration* of words from languages other than English (Greek, Hebrew Slavic [Russian Bulgarian etc.]) follows the procedure of the *U S Government Printing Office Style Manual* (1959)

9) *Missing bibliographic details* added for clarity (names dates publishers, etc) should appear in brackets For exceptions consult Bryant (1951)

Examples

Various problems encountered *in citing references are listed below* in boldface type, and examples are given.

Author Given names abbreviated to initials Abstract

Hildebrandt, A. C 1948 Influence of some carbon compounds on growth of plant tissue cultures in vitro (Abstr) Anat. Record 100 674.

Author Prefix in name Anglicized Miscellaneous publication

Van Dersal, W R. 1938 Native woody plants of the United States their erosion-control and wildlife values. U S Dept Agr Misc. Publ 303 362 p

Two papers same year lettered when citations not numbered
Name repeated

Magoon, M. L., R. W. Hougas and D. C. Cooper 1958a. Cytogenetic studies of tetraploid hybrids in Solanum from hexaploid-diploid matings. J. Heredity 49: 171–178

Magoon, M. L., R. W. Hougas and D. C. Cooper 1958b. Cytogenetic studies of complex hybrids in Solanum. J. Heredity 49: 285–293

Abbreviations of Words Used in Citations

Titles for journals can be abbreviated by combining the words listed below (single word titles are not abbreviated). The abbreviation appears in boldface type. The list is adapted from The Chemical Abstracts Service because that list is readily available. When a more widely acceptable list of abbreviations becomes available, it will be substituted for the present list.

Abhandlung
Abstract
Abteilung
Academia, Académica, Académie, Academy
Accademia
Administración, Administrador, Administration, Administrative
Agricola, Agrícola, Agricole, Agrícolo, Agricoltura, Agriculteur, Agricultural, Agriculture
Agrikultuurchemie
Agrogeological
Agronoma, Agronomia, Agronomi, Agronómica, Agronomicheskii, Agronómico, Agronomicum, Agronomie, Agronomique, Agronomy
Akadem, Akademia, Akademie, Akademija, Akademiya
Algemeen, Algemene
Allgemein
America, American, Americano
Analiticheskii, Analítica, Analitico, Analyse, Analytica, Analytical, Analytika, Analytique, Analytisch
Anatomia, Anatómica, Anatomical, Anatomie, Anatomisch, Anatomy
Angewandt
Annaes, Annalen, Annaler, Annales, Annali, Annals, Annuaire, Annual
Anuario
Antropologia
Anzeiger
Apiculture
Applicata, Application, Applicato, Applied, Appliqué
Arbeit
Arboriculture
Archaeology
Archief, Archiv, Archiva, Archives, Archivio, Archivum, Archiwum
Asociación
Associação, Associated, Association, Associations
Astrobotanika
Astronomical, Astronomicheskii, Astronomicum, Astronomique, Astronomiya
Azerbaidzhanskii
Bacteriologica, Bacteriological, Bacteriológico, Bactériologie, Bacteriology
Bakteriologie, Bakteriologisk
Beiheft
Belgica, Belgie, Belgique, Belgisch
Bericht
Biochemical, Biochemistry
Biochimica, Biochimico, Biochimique
Biogeochimique

cide Regulation Section 1957 A summary of certain pesticide chemical uses. Loose leaf n p

Author Federal agency (omitted as publisher) Revised edition:

U S Government Printing Office 1959 Style manual. Rev ed Washington 492 p

Book

Schwartz, R. J 1955 The complete dictionary of abbreviations. T Y Crowell Co., New York. 211 p

Book, Part of

Overstreet, H. A. 1925 The psychology of effective writing p 87–109 *In* H. A. Overstreet Influencing human behavior, Norton, New York.

Bulletin

Bryant Margaret S 1951 Bibliographic style U S. Dept. Agr *Bibliographic Bull. 16* *30* p

Illustrations not included in pagination and important

Smith, E. F 1917 Mechanism of tumor growth in crowngall J Agr Research 8 165–183, Figs 4–65

Newspaper (pages separated)

Maverick, M. 1944. The case against gobbledygook.' New York Times Mag May 21 11 35–36

Paper in a collection or book by various authors

Link, G K. K. 1928 Bacteria in relation to plant diseases, p 590–606 *In* E O Jordan and I S Falk, [ed] The newer knowledge of bacteriology and immunology Univ Chicago Press, Chicago

Patent original not seen

Penn F H 1942. Hydrogenated butter method U S Pat 2,272,578 Feb 10 Abstr in Offic Gaz U S Patent Office 535 322

Proceedings of society Series:

Salaman R. N., and F C Bawden. 1932 Analysis of some necrotic virus diseases of the potato Proc Roy Soc (London) B 111 53–73

Special part Edition Preposition omitted from English serial name Number paged separately

Riker A J 1946 Leaflet X. Inoculations with bacteria causing plant disease 3rd ed Pure culture study bacteria. 13(1) 15 p

Thesis on microfilm

Rafferty Nancy S 1958 A study of the relationship between the pronephros and the haploid syndrome in frog larvae. Ph.D Thesis. Univ of Illinois *(L. C Card No Mic 58-5470)* 41 p Univ Microfilms Ann Arbor Mich. (Dissertation Abstr 19 1146)

Two papers same year lettered when citations not numbered
Name repeated

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Agrikulturchemie
Agrogeological
Agronoma, Agronomia, Agronomie, Agronómica, Agronomicheskii, Agronómico, Agronomicum, Agronomie, Agronomique, Agronomy
Akadémi, Akademia, Akademie, Akademija, Akademiya
Algemeen, Algemeen
Allgemein
America, American, Americano
Analiticheskii, Analitica, Analitico, Analyse, Analytica, Analytical, Analytika, Analytique, Analytisch
Anatomia, Anatómica, Anatomical, Anatomie, Anatomisch, Anatomy
Angewandt
Annee, Annalen, Annaler, Annales, Anali, Annals, Annuaire, Annual
Annuario
Antropologia
Anzeiger
Apicultura
Applicata, Application, Applicato, Applied, Appliqué
Arbeit
Arboriculture
Archaeology
Archief, Archiv, Archiva, Archives, Archivio, Archivum, Archiwum
Asociacion
Associação, Associated, Association, Associazione
Astrobotanika
Astronomical, Astronomicheskii, Astronomicum, Astronomique, Astronomija
Azerbaidzhanskii
Bacteriologica, Bacteriological, Bacteriológico, Bactériologie, Bacteriology
Bakteriologie, Bakteriologisk
Beiheft
Belgica, Belgie, Belgique, Belgisch
Bericht
Biochemical, Biochemistry
Biochimica, Biochimico, Biochimique
Biogeochimique

Biogeokhimicheskii
Biokhemichnii
Biokhimicheskii, Biokhimik Biokhimiya
Biologi Biologia, Biologia, Biológiai Biologica, Biological Biológico *Biologie Biologique Biologisch* Biologischeskii Biologisk Biologiya Biology
Biophysica, Biophysica
Bioquimica
Boletim Boletin
Bollettino
Botanic Botanica, Botánica Botanical Botanischeskii Botánico Botanico Botanik Botanika Botanique Botanisch Botanisk
Bulletin Bulletino
Bureau
Cechoslovaca Cechoslovakisch
Chemica, Chemical Chemické Chemicky Chemie Chemik Chemisch Chemistry Chemja
Chimica, Chimico Chimie Chimie Chimika Chimique
Chirurgia, Chirurgica *Chirurgicale* Chirurgico Chirurgie
Chromatography
Circulars
Cirkulär
Clinic Clinica Clinical Clinique
College
Colloque Colloquio Colloquium
Commission
Committee
Communicata Communication
Comparative
Compte
Conference Conférence Conferencia Conferencia
Congrès Congreso Congress
Conservation
Contribución Contribution
Cultural Culturale
Cytochemistry
Cytologie Cytology
Czechoslovak
Denmark
Departamento Department
Deutsch Deutschland
Divisão Division Divisional
Documento Documentary Documentation
Ecologia Ecological Ecology
Economía Economía Economic Economica Économie Économique
Edition Edizione
Educación Education
Electroencephalography
Embriologia
Engenharia Engine Engineering
Engineer
England
Enologia Enologico Enology
Entomologia Entomologia, Entomological Entomologie Entomologique Entomologisch, Entomology
Enzymology
Epidemiologie Epidemiologiya, Epidemiology
Ergebnis
Estudiante Estudio Estudo
Experiment Experimentation
Experimental Expérimental Experimentalis
Facoltà, Faculdade Facultad Facultas Faculté Faculty
Fakulta Fakultät Fakultato Fakultet
Farmacologia, Farmacologisch
Finnisch Finnish
Forschung
Fortschritt
Gazeta Gazette Gazetteer
Genèl General Générale Generale
Genetic Genetica, Genetical Genetics Genetika
Geologi Geologia Geologie Geologica Geological Geologicheskii Geologichnii, Geologiczny Geólogie Geologisk, Geology
German
Gerontologia Gerontologica, Gerontology
Gesamt Gesellschaft

Giornale
Government
Great Britain
Helminthological, Helminthology
Helvetia, Helvetica, Helvétique
Hépatologie
Histoire Historia, História, Historica History
Histologie
Hungarian, Hungarica, Hungary
Hydrobiologia
Hygiene Hygiène Hygiène Hygienic Hygienisch
Ichthyology
Immunobiologiya, Immunobiology
Immunologia, Immunologie Immunology
Incorporated
Information
Institut Instituto, Institution, Instituto Institutul, Institutum, Instytut
Internacional, International International, Internationalis, Internationalis, Internazionale
Investigación, Investigazioni, Investigation, Investigative
Investiya
Jahrbuch
Jornal, Journal
Klinik
Klinicheskii, Klinik, Klinika, Klinisch
Kongres Kongress
Krankheit
Laboratoire, Laboratorio Laboratorium Laboratoriya, Laboratornyi, Laboratory
Latinoamericana
Lebensmittel
Management
Manufacturing
Mathematica, Mathematics Mathematik Mathématique Mathematisch
Médecine Medica, Medical Medicine Medicinal, Medico Medisch, Meditsina, Meditsinskii, Medizin Medycyna
Memoir Mémoire Memorandum Memoria, Memorial, Memoria
Meteorological, Meteorologica, Meteorologico Météorologique
Mexicano Mexico, México
Microbiologia, Microbiologica, Microbiologie Microbiology
Microscopica, Microscopical, Microscopista
Mikrobiologicheskii, Mikrobiologischii, Mikrobiologie Mikrobiologiya
Miscelánea Miscellanea, Miscellaneous
Morfologicheskii, Morfologie Morfologia
Morphologica, Morphologie Morphology
Mycologia, Mycologica Mycologici Mycologie Mycologisch, Mycology
Nacional
Nationaal National Nationalis
Natura, Natural, Naturalia, Naturalis, Naturalista
Nederland Nederlandsch
Neurologica, Neurological Neurologie Neurology
Neuropathology
Neurophysiology
Neurosurgery
Oceanografia, Oceanographic Océanographique Oceanography
Official Officiel, Officinale
Ophthalmologica, Ophthalmologie Ophthalmology
Paleontology
Pamflet, Pamphlet
Parasitologia, Parasitologie Parasitology
Part
Patent
Pathologica, Pathologie, Pathologisch Pathology
Pharmaceutica, Pharmaceutique Pharmaceutisch, Pharmacie Pharmacy Pharmazie

Biogeokhimicheskii
Biokhemichnii
Biokhimicheskii Biokhimik, Biokhimiya
Biologi Biologia, Biologia Biológiai Biologica, Biological Biológico Biologie Biologique Biologisch Biologicheskii Biologisk Biologiya, Biology
Biophysica Biophysics
Bioquimica
Boletim Boletin
Bollettino
Botanic Botanica Botánica Botanical Botanicheskii Botánico Botanico Botanik Botanika Botanique Botanisch Botanisk
Bulletin Bullettino
Bureau
Cechoslovaca, Cechoslovakisch
Chemica, Chemical Chemické Chemicky Chemie Chemik Chemisch Chemistry Chemja
Chimica Chimico Chimie Chimie Chimika, *Chimique*
Chirurgia, Chirurgica Chirurgicale Chirurgico Chirurgie
Chromatography
Circulars
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Clinic Clinica Clinical Clinique
College
Colloque Colloquio Colloquium
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Communicata Communication
Comparative
Compte
Conference Conférence Conferencia Conferencia
Congrès Congreso Congress
Conservation
Contribución, Contribution
Cultural Culturale
Cytochemistry
Cytologie Cytology
Czechoslovak
Denmark
Departamento Department
Deutsch Deutschland
Divisão Division Divisional
Documento Documentary Documentation
Ecologia Ecological Ecology
Economia Economia Economic Economics Économie Économique
Edition Edizione
Educación Education
Electroencephalography
Embriologia
Engenharia Engine Engineering
Engineer
England
Enologia, Enologico Enology
Entomologia, Entomologia, Entomological Entomologie Entomologique Entomologisch, Entomology
Enzymology
Epidemiologe Epidemiologiya Epidemiology
Ergebnis
Estudiante Estudio Estudo
Experiment Experimentation
Experimental Expérimental Experimentalis
Facoltà, Faculdade Facultad Facultas Faculté Faculty
Fakulta, Fakultät Fakultato Fakultet
Farmacologia Farmacologisch
Finnisch Finnish
Forschung
Fortschritt
Gazeta Gazette Gazetteer
Genl General Générale Generale
Genetic Genetica, Genetical Genetics Genetika
Geologi Geologia Geologic Geologica Geological Geologicheskii Geologichnii Geologiczny Geólogie Geologisk, Geology
German
Gerontologia, Gerontologica Gerontology
Gesamt Gesellschaft

American Journal of Botany
American Journal of Human Genetics, The
American Journal of Physical Anthropology
American Journal of Physiology
American Journal of Psychology, The
American Journal of Tropical Medicine and Hygiene
American Midland Naturalist, The
American Potato Journal
American Psychologist, The
Anatomical Record, The
Annals of the Entomological Society of America
Applied Microbiology
Archives of Oral Biology
Arthritis and Rheumatism
Auk, The: A Quarterly Journal of Ornithology
Bacteriological Reviews
Biological Abstracts
Biological Bulletin, The
Blood
Botanical Gazette
Brittonia
Bryologist, The
Bulletin of Mathematical Biophysics
Bulletin of the Entomological Society of America
Bulletin of the Florida State Museum, Biological Sciences
Bulletin of the Research Council of Israel. Section B: Zoology; Section D: Botany; Section E: Experimental Medicine
Bulletin of the Torrey Botanical Club
Circulation Research
Contemporary Psychology: A Journal of Reviews
Copeia
Ecological Monographs
Ecology
Economic Botany
Entomological News
Evolution
Experimental Parasitology
Federation Proceedings
Forest Science
Growth. A Journal for Studies of Development and Increase
Human Biology
Illinois Natural History Survey Biological Notes
Illinois Natural History Survey Bulletin
Illinois Natural History Survey Circular
Illinois Natural History Survey Manual
International Bulletin of Bacteriological Nomenclature and Taxonomy
Iowa State Journal of Science
Iowa, State University of, Studies in Natural History
Journal of Abnormal and Social Psychology
Journal of Animal Science
Journal of Applied Physiology
Journal of Applied Psychology
Journal of Bacteriology
Journal of Biological Chemistry, The
Journal of Biophysical and Biochemical Cytology
Journal of Comparative and Physiological Psychology
Journal of Consulting Psychology
Journal of Dairy Science
Journal of Economic Entomology
Journal of Educational Psychology
Journal of Experimental Psychology
Journal of Histochemistry and Cytochemistry, The
Journal of Immunology
Journal of Insect Pathology
Journal of Lipid Research
Journal of Mammalogy
Journal of the National Cancer Institute
Journal of Parasitology, The
Journal of Pharmacology and Experimental Therapeutics
Journal of Protozoology, The
Journal of Wildlife Management
Limnology and Oceanography

Pharmacologia, Pharmacologica Pharmacologique Pharmacology
Physica, Physical Physics, Physicum, Physique Physisch
Physiologie Physiologica Physiological Physiologe Physiologique Physiologisch Physiology
Phytochimica
Phytopathological Phytopathologisch
Preservation
Proceedings
Produção Product
Progrès Progreso Progress, Progresso
Protozoology
Publicação Publicación Publicatie Publication Publikace Publikation Publikatsiya
Quarterly
Radiobiologia
Radiologia, Radiologie Radiologiya Radiology
Recueil
Referativnyi
Report
Republic República Republika, *République*
Review Revistă Revue Reviews
Rivista
Royal Royaume
Russe Russian Russisch Russkii
Scandinavian Scandinavica
Science Scientia Scientific Scientifico Scientifique Scienza
Scotland Scottish
Secretary
Serie Series
Serologie Serology
Service Servicio Serviço
Silviculture
Sociedad Sociedade Società, Societas Societate Société Societet Society
Special
Sperimentale Sperimentazione
Station
Statistics
Supplement Supplementum
Surgery Surgical
Technica, Technical Technický Technics Technicany Techniek Technik Technika Technikum Technique, Technisch
Technological Technologie Technologique Technology
Tijdschrift
Toxicologica Toxicological Toxicologie Toxicology
Transaction
Translation
Travaux
Tydskrif
Universidad Universidade Università, Universität Universitas Universiteit Universitet University
Untersuchung
Veterinaer Vétérinaire Veterinaria Veterinario Veterinary
Volume
Wildlife
Wissenschaft Wissenschaftlich
Wochenschrift
Yearbook
Zeitschrift
Zeitung
Zentralblatt
Zhurnal
Zoologi Zoologia Zoologicheskii Zoológico Zoologie Zoologisch

Abbreviations for Serial Publications

The publications listed below are represented in the Conference of Biological Editors and are chosen as examples of how to abbreviate journal titles using the above words. The abbreviations are set in bold face

Agronomy Journal
American Biology Teacher
American Forests
American Institute of Biological Sciences *Bulletin*
American Journal of Anatomy The

American Journal of Botany
American Journal of Human Genetics, The
American Journal of Physical Anthropology
American Journal of Physiology
American Journal of Psychology The
American Journal of Tropical Medicine and Hygiene
American Midland Naturalist The
American Potat Journal
American Psychologist The
Anatomical Record, The
Annals of the Entomological Society of America
Applied Microbiology
Archives of Oral Biology
Arthritis nd Rheumatism
Auk, The. A Quarterly Journal of Ornithology
Bacteriological Reviews
Biological Abstracts
Biological Bulletin, The
Blood
Botanical Gazette
Brittonia
Bryologist The
Bulletin of Mathematical Biophysics
Bulletin of the Entomological Society of America
Bulletin of the Florida Stat Museum, Biological Sciences
Bulletin of the Research Council of Israel. Section B Zoology Section D Botany Section E. Experimental Medicine
Bulletin of the Torrey Botanical Club
Circulation Research
Contemporary Psychology A Journal of Reviews
Copeia
Ecological Monographs
Ecology
Economic Botany
Entomological News
Evolution
Experimental Parasitology
Federation Proceedings
Forest Science
Growth. A Journal for Studies of Development and Increase
Human Biology
Illinois Natural History Survey Biological Notes
Illinois N tural History Survey Bulletin
Illinois Natural History Survey Circular
Illinois N tural History Survey Manual
International Bulletin of Bacteriological Nomenclature and Taxonomy
Iowa Stat Journal of Science
Iowa Stat University of Studies in N tural History
Journal of Abnormal and Social P y hology
Journal of Animal Science
Journal of Applied Physiology
Journal of Applied Psychology
Journal of Bacteriology
Journal of Biological Chemistry The
Journal of Biophysical and Biochemical Cytology
Journal of Comparative and Physiological P ychology
Journal of Consulting Psychology
Journal of Dairy Science
Journal of Economic Entomology
Journal of Educational Psychology
Journal of Experimental Psychology
Journal of Histochemistry and Cytochemistry The
Journal of Immunology
Journal of Insect Pathology
Journal of Lipid Research
Journal of Mammalogy
Journal of the National Cancer Institute
Journal of Parasitology The
Journal of Pharmacology and Experimental Therapeutics
Journal of Protozoology The
Journal of Wildlife Management
Limnology and Oceanography

Lloydia. A quarterly Journal of Biological Science
Metabolism
Michigan State University Agricultural Experiment Station Technical Bulletin
Mycologia
Ohio Journal of Science The
Papers of the Michigan Academy of Science Arts, and Letters
Physiological Reviews
Physiologist The
Phytopathology
Plant Physiology
Proceedings North Central Weed Control Conference
Proceedings of the Academy of Natural Sciences Philadelphia
Proceedings of the *American Society* for Horticultural Science
Proceedings of the Biological Society *of Washington*
Proceedings of the Society for Experimental Biology and Medicine
Progress in Cardiovascular Diseases
Psychological Abstracts
Psychological Bulletin
Psychological Monographs
Psychological Review
Public Health Reports (U.S)
Quarterly Journal of the Florida Academy of Sciences The
Quarterly Review of Biology The
Science
Soil Science Society *of* America, Proceedings
Systematic Zoology
Transactions *of American* Fisheries Society
Transactions of the American Microscopical *Society*
Transactions of the North American Wildlife Conference
Transactions of the Wisconsin Academy of Science Arts and Letters
Weeds
Wildlife Disease
Wildlife Review
Wilson Bulletin, The

LITERATURE CITED SECTION II

American Ornithologists Union. 1957 Check list of North American birds. 5th ed American Ornithologists Union. Ithaca N Y 691 p

Breed, R. S E G D Murray and N R. Smith. 1957 Bergey's manual of determinative bacteriology 7th ed Williams & Wilkins Co Baltimore 1094 p

Bryant Margaret S 1951 Bibliographic style U S Dept Agr Bibliographic Bull 16 30 p

Buchanan, R. E. (*chmn*) S T Cowan (*sec*) T Wiken (*sec.*) and W A. Clark (*sec*) Editorial Board 1958 International code of nomenclature of bacteria and viruses Iowa State College Press Ames 186 p

Chemical Abstracts Service 1956–1900 List of periodicals abstracted by *Chemical* Abstracts with keys to library files and other information. Ohio State Univ Columbus 10 Ohio 314 p (Supplements 195–1900)

Cockrum E. Lendell 1957 Laboratory manual of mammalogy *Burgess Publishing* Co Minneapolis Minn 160 p

Entomological Society of America Committee on Common Names of Insects (R. I. Sailer *Chmn*) 1955 Common names *of insects approved by the Entomological* Society of America. Bull Entomol Soc Am 1(4): 1–34

International Trust for Zoological Nomenclature 1958 Official list of generic names in zoology 1958 Part 1 names 1 12*4. Official list *of family-group* names in zoology 1958 Part 1 names 1–230 International Zoological Trust London.

Lanjouw J. (*Chief Editor*) and F. A. Stafleu (*sec.*) Editorial Committee. 1956. International code of botanical nomenclature. Kemink en Zoon, Utrecht. 338 p.

Lawrence, G. H. M. 1951. Taxonomy of vascular plants. Macmillan Co., New York. 823 p.

Metcalf, Z. P. 1954. The construction of keys. Systematic Zool. 3: 38–45. Fig. 1–6.

Schenk, E. T., and J. H. McMasters. 1956. Procedure in taxonomy. 3rd ed. Stanford Univ. Press, Stanford, California. 119 p.

U. S. Government Printing Office. 1959. U. S. Government Printing Office style manual. Rev. ed. Washington. 497 p.

Vilmorin, R. de, *Chairman*, Editorial Committee of International Commission for Nomenclature of Cultivated Plants (IUBS). 1958. International code of nomenclature for cultivated plants. Regnum Vegetabile 10: 1–28. Utrecht.

Woerdeman, M. W. 1957. Nomina anatomica Parisiensia (1955) et B.N.A. (1895). A. Oosthoek Publishing Co., Utrecht. 174 p. *See also* p. 1004–1038, Stedman's medical dictionary. 1957. 19th ed. Williams & Wilkins Co., Baltimore.

Wolf, F. A., and F. T. Wolf. 1947. The fungi. vol I, p. 163. John Wiley & Sons, New York.

III APPROVAL OF MANSCRIPTS AND RELEASE OF RESULTS

The author should obtain approval from the responsible official within his institution before submitting a manuscript, to safeguard the interests of all staff members against erroneous or premature publication

Technical and institutional information may not be released to the press without permission of both the investigators and responsible ad ministrators.

The first report should be published in a scientific journal or presented before a scientific society Release to news services may follow

The investigator should check the press report carefully before its release.

Nothing here is to be interpreted as censorship The intent is to protect all concerned, including the press against embarrassing errors.

IV REVIEW OF MANUSCRIPTS

Editors customarily send a manuscript to qualified reviewers who can help the author avoid error or misunderstanding and add strength and dignity to his presentation. Usually a reviewer remains anonymous but he may identify himself if he wishes. Reviewers are on the author's side whether appreciated or not An author should take the reviewer's comments seriously and answer criticisms by improving his manuscript not by debate Misunderstanding by the reviewer usually arises from lack of clarity in the manuscript. Few papers are accepted outright. If the author rejects an important suggestion, he should tell the editor why The editor is responsible only for the form of the published paper and the author remains responsible for all statements in it.

SUGGESTIONS TO REFEREES

If a manuscript is too long the author will not be helped by the comment, "This manuscript is too long. Condense it to half" Give clear-cut directions for eliminating unimportant portions or condensing expanded writing. The reviewer should indicate grammatical and rhetorical errors (but his own remarks should be free from similar errors) Avoid changing the writer's style if his meaning is clear and if the text is neither verbose nor cryptic. Be considerate One test of a good critique is whether the reviewer would be willing to sign it Keep an open mind. A wise reviewer will not consider his own opinions infallible. There is real danger of rejecting a "breakthrough" manuscript as a "crackpot" paper Reviewers must treat the manuscript as confidential

Consider the following

1) Return two copies of the criticism, one of which the editor may send to the author Copies may or may not be signed.
2) Avoid acrimony
3) Grade the paper as superior good, acceptable (with revision) or unacceptable on both its scientific merit and its form. Also advise the editor on the suitability and acceptability of the abstract
4) Return manuscripts and comments promptly Advise the editor if you anticipate a delay of more than 2 weeks.
5) a) Has the material been published previously in the same or similar form?

   b) Do all parts warrant publication? The American Documenta

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V COPY EDITING

TYPE FACE

Italics (marked by single underlining)

Use italics for:

1) names of books and periodicals in the text but not in the literature cited
2) foreign words and phrases and their abbreviations, but not for proper names. Many foreign words are now widely used in English and need not be set in italics (a priori, attaché, in vitro, in vivo, et al.)
3) mathematical matter for all unknowns and constants (but use roman for differential d in dy/dx, for abbreviations of trigonometric functions, and log)
4) scientific names of genera, species, subspecies, and varieties; names of higher taxa may be italicized.
5) letters or numbers in text which refer to corresponding letters or numbers in an illustration
6) single letters and words themselves under discussion
7) first occurrence of special terms
8) emphasizing words or phrases only when other means of emphasis are not satisfactory (but overuse destroys the emphasis)
9) titles and legends for tables and figures (*see* p. 37 and 40)
10) cross-reference and indexes for expressions *see*, *see also*

Small Capitals (marked by double underlining)

Follow the style of the journal to which the paper is to be submitted. Some journals use small capitals for AD (AD 65), BC (in 31 BC), PM, AM, and for abbreviations of government or international agencies such as AEC, UNESCO. See page 60 for the use of small capitals in names of chemical compounds. Use small capitals for:

1) headings for figures and tables: FIG. 1, TABLE 2. In the text abbreviate *figure* (Fig.) but not *table* (Table)
2) SD (standard deviation)
3) SE (standard error)
4) N (normality)
5) M (molarity)
6) LD_{50}, ID_{50}, etc., but MLD

Boldface (marked by wavy underlining)

tion Institute Auxiliary Publication Service (administered by the Library of Congress), accepts for permanent deposit supplementary material (tabular data, illustrations, flow sheets, reference lists, etc.) for papers in journals. By arrangement, an editor may place a note (giving accession number and price) in a paper stating that auxiliary material is on deposit, and available to anyone as a photocopy

c) Is some other journal more suitable?
d) Is the manuscript in proper form? Reviewers should suggest minor corrections in diction style etc. on the manuscript
e) Is the arrangement of the paper satisfactory and economical? Have any ideas been under or over-emphasized? Should parts be expanded, condensed or omitted? Is there unnecessary repetition or duplication? Make specific suggestions.
f) Is the author s writing clear? If not, suggest improvements If he has any bad writing habits, indicate diplomatically how to correct them.
g) Can you suggest improvements for the illustrations? Are any of them unnecessary? Are more needed? Are they numbered and lettered? Will the smallest lettering be clear after the necessary reduction?
h) Are there errors of fact interpretation, or calculation?
i) Were the technical and experimental methods adequate?
j) Do the tables present the data clearly and concisely?
k) Does the author have adequate knowledge of the pertinent literature? Are there too many or too few citations listed? Are they in the proper form?

13) the first word after a colon if the following words form a complete independent clause that is not logically dependent on the preceding clause

PRINTERS MEASUREMENTS AND SIZES OF TYPE

Printers' measurements are based on the point (= 0.01384 inch) A "pica" is 12 points there are about 72 points or 6 picas to an inch. Size of paper covers, engravings trim size of page and margins are usually expressed in inches length of type line and width and depth of columns are expressed in picas size of type and leads, the thickness of rules and spaces are expressed in points The size of any font of type includes the height of ascenders (d, f) or capital letters, and the depth of descenders (j q) Equivalents of the various units are as follows

1 inch = 6 picas = 72 points
1 pica = 12 points = 1/6 inch
1 point = 1/72 inch = 1/12 pica

The "em" is a square of the body height of any size of type A 1-em dash (—) in a 9-point type is 9 points long (length of the capital M in that font) One em is equal in length to 2 en. Usually paragraphs are indented 1 em.

Rules (——) used in print have their thickness expressed in points and their length in picas. The one shown is 1-point, 2 picas.

Leaders ( ) have their length expressed in ems and the size controlled by the specific type used.

Standard type is available in sizes from 6-point to 60-point. Most articles in scientific journals are set in 8- or 10-point type usually with 1 or 2-point leading (space) between printed lines This paragraph is set in 10-point type with 2-point leading, customarily expressed as 10/12.

This sentence is set in lower case 6-point roman type

These are CAPITALS and SMALL CAPITALS in 8-point type

This is *italic* and **boldface** 10-point type

This type useful for headings, is 12 point

This line is set in 18-point type

The text of this manual is set in 10 point the first headings in 18 point, and the tables in 8 or 6 point.

CASTING OFF

This is a device for copy fitting and determining the space that will be occupied by a particular typescript when set in type of a certain size.

Mark for boldface

1) names of genera, species, and subspecific taxa proposed for the first time
2) vectors in mathematics

Capitals (marked by triple underlining only where intention is not clear)

Use for

1) *proper nouns and some proper adjectives.* But words derived from nouns, which have a specialized meaning need not be capitalized *petri dish paris green, bunsen burner, italicize pasteurize*
2) the first letter of each sentence
3) only the first word and proper names in titles of books and journal articles in literature citations
4) the initial letter of official titles of courtesy when the titles must be used
5) the official names of private or government organizations and institutions but not the shortened form of such names unless necessary to avoid ambiguity
6) generic geographical terms that follow a proper name (river Mississippi River)
7) names of historical epochs, geologic ages and strata, zoogeographic zones, and other terms used for convenience of classification. The terms *age era, epoch period till glaciation,* and others need not be capitalized unless ambiguity might result Neolithic age Stone Age Ice Age Pleistocene epoch
8) scientific names of phyla, orders, classes families, and genera but not of species or subspecific taxa (except where permitted by the *Botanical code*)
9) complete vernacular or common names of species (but not subspecies) of birds in accordance with the check list of the American Ornithologists Union (1957) (*see* p 54) Examples Bald Eagle Ruby throated Hummingbird Great Auk *but* eagle hummingbird and auk
10) common names *of insects only when in accordance* with the list approved by the Entomological Society of America (*see* p 54) Examples Alaska spruce beetle American grasshopper Chinese mantis, Virginia-creeper sphinx
11) names of stars and other astronomical bodies. (Earth moon and sun need not be capitalized except when they are used in a paper containing other astronomical terms.)
12) trade-marked names do not use adjectives derived from trade names.

VI PROOF

TEXT

The galley proofs usually the only proofs the author sees before publication, are the first indication of how his work will finally appear Remember that these are imprints on cheap paper made on a hand press with no breaks between pages and are usually covered with queries and symbols. Galley proofs are never as clear-cut as final printing. Never cut the proof sheets never obliterate the coded marks at the top—they identify the typesetter location of type and other essentials and will be removed later Never erase or eradicate marks on the proof if an indicated change is not desired, cross it out and mark "stet" or "OK as set" beside it, and underline with dots the words to be retained.

Galleys are marked by the printer or the editor with various corrections, changes and queries to the author The author should explicitly answer each query (indicated by question mark) Avoid using an ambiguous "OK" in answer to a query If you want the material to remain as set, cross out the question mark. In resetting the type from corrected galleys, the compositor does not read for sense but scans the margins and resets only those lines marked for changes. Make all corrections neatly clearly and horizontally opposite the line to which they apply Insertions of more than one line should be typed and attached (by paste or glue) as flyers to the galley at the point where they occur *All* changes must be on the galley sheets not in an accompanying letter The typesetter has no means of following an extra set of instructions, nor the time *or inclination to run through the author's reasons for changes.*

Check the proof, word for word, against the typescript, preferably with another person, and reading aloud. Verify all unusual names all numerical data, bibliographic references, and the like against original sources. Do not use blanket orders, such as "set *Rosa* in italics through out." Each individual instance must be marked. Mark galleys in a different color from marks already there It is customary for authors to mark printer's errors in red, author's alterations in blue or black. Indicate the position of figures and tables by a marginal notation, with a circle around it, also circle all notes and instructions not to be set in type

PROOFREADERS MARKS

Learn and use the customary proofreaders' marks (Fig. 3)

Correction requires two marks on the galley—one in the margin indi

Ordinary typewriters print the same number of characters or spaces per inch (10 for pica, 12 for elite typewriters)

In printers types letters are of many widths capitals are wider than lower case letters, the *w* and *m* are wider than *e* and *h*, and the *i* and *l* narrower but these differences tend to average out. Printers can provide estimates of the number of characters per pica for any size of any font. For example Caledonia type sets 3 14 characters per pica (in 8 point) 2 63 (in 10 point) or 2.26 (in 12 point) A simple formula for computing the number of printed pages from any manuscript is this

No of printed pages =

$$\frac{\text{(No. MS lines per page)} \times \text{(Characters and spaces per MS line)} \times \text{(No. of MS pages)}}{\text{(Characters and spaces per printed line)} \times \text{(No. lines per printed page)}}$$

cating what is to be done and another within the type indicating by a short perpendicular line or a caret (∧) the exact place where the change is to be made. If several corrections occur in one line, mark them from left to right, and separate them by a long slant line (/) in the nearest margin.

Galley proof is not the place for extensive changes. If necessary, however, new material can often be added *at the end of a paragraph or as a new paragraph*. But an account of discoveries or observations made after the original manuscript was submitted must not be added this way. It is not ethical. Such matter belongs in an addendum and requires the permission of the editor for inclusion. Insertions within the paragraph should, if possible, equal the deleted material letter for letter.

Figure 4 is a sample set in type (with more than the usual number of corrections) showing the necessary proofreaders' marks.

Nothing whatsoever should be added to or deleted from the original typescript. Return the typescript with the galleys.

ALTERATIONS

Once type is set, changes are far more costly than the original typesetting operation. Much text matter is set on linotype machines, i.e., an entire line is cast as one "slug"; any change requires resetting the entire line. Additions often necessitate resetting the rest of the paragraph. Printer's errors are corrected at no cost to the author. The original manuscript, as marked for the printer by the editor, is the authority for identifying printer's errors and author's corrections. Printers and editors are grateful when authors clearly identify changes from the original copy. Above a certain minimum, authors are usually charged for the labor of making alterations. Since compositors are well paid, it behooves the author to submit letter-perfect manuscript.

ILLUSTRATIONS

Proofs of halftones on galley paper show much less detail and contrast than the finished product. Judge halftones by engraver's proofs. Line cuts with minor faults may sometimes be repaired by cutting out or adding small details. Necessary corrections should be added at the margin and the engraver's proofs returned. Usually, if the original art work was satisfactory, corrections are unnecessary and the originals need not be returned. Identification of the figure should be marked on the proofs and if there is the slightest possibility of confusion, the proper edge of the proof should be marked "top." Check the stated magnification of all illustrations.

⊙ Period

, Comma

= Hyphen

Colon

, Semicolon

Apostrophe

Quotations

□ Indent one em double for two em and so on

One em dash

Two em parallel dash

Push down lead or space

Close up

Less space

∧ Caret—something to be inserted

Turn letter or line

Insert space

[or] Move to left or to right

Move up or move down

( ) Parentheses

[ ] Brackets

tr Transpose

out Out see copy (be sure manuscript is returned if this is used)

Character to go around letters words or phrases to indicate that they are to be transposed Always include "tr" on margin of proof

stet Let it stand when something has been inadvertently crossed out Dots under matter will usually suffice but also include stet on margin to avoid misunderstanding

Delete—take out

× Broken letters or defective type

¶ Paragraph

no ¶ No paragraph

wf Wrong font

/// Equalize spacing

≡ Capitals and cap

= Small capitals and sm cap

lc Lower case

Superior or inferior letters or figures

—— Italics, and ital

rom Roman

spell Spell out if figure

(2) Circle around figures means spell out

Bold face bf

FIG 3 *Proofreaders marks*

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Fawns Versus Food

It is basic in animal biology that far more young are produced than necessary to carry on the species. This is true of ants, elephants, people and deer The better nourished a doe is, the more fawns she produces and the bettter chances her fawns have for survival after birth. One of the principles of deer herd management, or livestock raising, can be briefly stated: If on a given amount of food we carry a smaller number of bred females overwinter each one will be better fed 10 well fed does will produce at least as many fawns as 15 half starved ones. This has been proven beyond question Michigan is no exception to this rule In the upper peninsula the average rate of fawn production is 14 or 15 fawns per year from every 10 breeding does and in southern Michigan fawn production jumps up to 20 per 10 does.

—Michigan Whitetails 1959

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FIG. 4 *Portion of corrected galley proof*

HANDLING OF PROOF FOR FOREIGN AUTHORS

To reduce postal expense, foreign authors too often submit manuscripts typed on onionskin paper single-spaced, with scanty margins. Such manuscripts are unacceptable. As nearly as possible all manuscripts, whether domestic or foreign, are treated the same. Air mail is recommended for all transactions between editors and foreign authors. A foreign author often has some American colleague deal for him with the editor concerning minor changes, rewrites, proofreading, and ordering of reprints.

VII INDEXING

An index is one of the most important means for retrieving scientific information Scientific papers rarely have a separate index but journals, books, and other documentary materials should have good indexes.

Authors may prepare indexes but generally either the editor or an experienced indexer does this. Rules and instructions for making an index are given in references cited and in the Final Report (October 1958) of Z-39 Subcommittee on Indexing American Standards Association

A few important suggestions are

1) Make the index promptly from page proof Index all material in the introduction main text, footnotes, and addenda
2) Mark on the proof key words and names, significant phrases, and ideas or hypotheses. Key words are nouns or substantive phrases, not adjectives. Copy these items on filing cards one entry to a card or on perforated cards or paper Arrange the items in alphabetical order and then sort into main headings and subheadings making sure that each refers properly to the main subject for example

    Ant(s) red diseases of 1 10
    Blackberry effect of temperature on storage of 2
    Cold frames, plastic covers for 8 9 10
    DeForest, Lee 100
    Energy derived from carbohydrates 7
    Feline pneumonitis virus review of 4

3) Capitalize initial words of main headings. In complex indexes, capitals and small capitals, italics, and boldface may be used to distinguish entries.
4) In multiple-word headings use the word-by word method of alphabetizing (New York before Newark) rather than the letter-by-letter method File entries having the same name alphabetically (New York City Port -State)
5) File hyphenated entries as if separate words.
6) File abbreviations as if spelled out
7) File numbers as if spelled out except that historical periods (17th century 18th century) are filed chronologically Numbers, Greek letters (α β γ) ortho- meta para sec tert- *d* *l* D- L- etc. used in chemical nomenclature are not alphabetized except when establishing position under a heading.

8) Use a comma after headings and between two prepositions to stand for the inverted object of the first preposition. Dashes may be used in place of headings or subheadings when the entry is repeated often.
9) Cross-reference the index to as many headings as desirable. Use a cross reference (*see*) from an entry to a synonymous term, and (*see also*) from an entry to another on a related subject. File *see also* references alphabetically before all other entries under a heading; if of minor significance file under subheading or omit.

VIII USEFUL REFERENCES

Besides an up-to-date dictionary (*Webster's New International Dictionary* is preferred) an author or editor may get help from a variety of reference works. A few authoritative and generally useful books and articles are

Andrews E. 1947 A history of scientific English. The story of its evolution based on a study of biomedical terminology Richard R. Smith New York. 342 p

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